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IMPROVEMENT OF OPERATIONS AND MAINTENANCE TECHNIQUES RESEARCH PROGRAM

TECHNICAL REPORT HL-88-20

INVENTORY OF TRAINING STRUCTURES IN ESTUARIES

by

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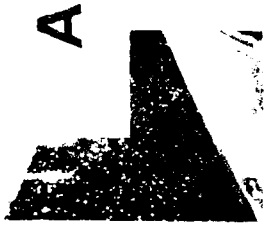

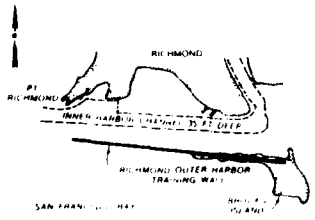

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This report inventories training structures in estuaries. The ultimate goal of the research is to improve design guidance for the effective use of training structures in estuaries. This inventory is the result of literature and map surveys to determine what structures exist in the estuaries and is the first of three planned stages of research.

Several structures will be selected for further detailed data retrieval. The structures will then be modelled in both a physical model (flume) and a numerical model. The resulting product will be a numerical method verified by prototype and physical model data to assist during the design stage for estuarine training structures. The method will also aid engineers in determining the effectiveness of existing structures.

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PREFACE

A survey of US Army Corps of Engineers project maps was conducted and this inventory compiled by personnel of the Estuaries Division, Hydraulics Laboratory (HL), of the US Army Engineer Waterways Experiment Station (WES), under the Improvement of Operations and Maintenance Techniques (IOMT) research program sponsored by the Headquarters, US Army Corps of Engineers (USACE), under IOMT Work Unit No. 32350, "Estuarine Channel Maintenance by Training Structures." Additional funding was provided by the Repair, Evaluation, Maintenance, and Rehabilitation (REMR) research program, under REMR Work Unit No. 32323, "Scour Detection and Repair."

The survey was conducted by Messrs. Walter Pankow and Michael J. Trawle, under the general supervision of Messrs. Frank A. Herrmann, Jr., Chief, HL; Richard A. Sager, Assistant Chief, HL; William H. McAnally, Jr., Chief, Estuaries Division; and E. Clark McNair, Jr., IOMT Program Manager. Messrs. Jim Gottesman and Charles Hummer were USACE Technical Monitors. This report was edited by Mrs. Marsha Gay, Information Technology Laboratory, WES.

COL Dwayne G. Lee, CE, is the Commander and Director of WES. Dr. Robert W. Whalin is the Technical Director.

CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC)
UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
feet	0.3048	metres
miles (US statute)	1.609347	kilometres

INVENTORY OF
TRAINING STRUCTURES IN ESTUARIES

PART I: INTRODUCTION

Background

1. Over 550 training structures constructed and maintained by the US Army Corps of Engineers exist in estuaries of the contiguous United States. The primary purpose of these structures is to minimize maintenance dredging requirements in federally maintained navigation projects. In general, the structures are included within overall navigation projects and not noted separately. In order to inventory specific training structures, a review of estuarine navigation project maps was conducted. This inventory is the result of that research.

2. These structures could be categorized in a variety of ways; but for the purpose of this report, each training structure has been assigned to one of four categories: lateral dikes, longitudinal dikes, barrier dikes, and jetties.

a. Lateral dikes are defined as structures that are generally aligned transverse to the flow. This type of structure is usually designed to constrict flow within a smaller cross-sectional area, thus increasing current velocities in critical channel reaches. This type of structure often also has a secondary role, that of bank protection.

b. Longitudinal dikes are defined as structures that are generally aligned parallel to the flow. This type of structure works in critical channel reaches by causing a flow redistribution of sufficient magnitude to significantly increase channel velocities. Usually the structures tend to align or concentrate the flow along the navigation channel.

c. Barrier dikes are defined as structures that are placed to eliminate the migration of sediment from adjacent areas into navigation channels. This type of dike is not designed to increase channel velocities but to isolate the channel from a sediment source.

d. Jetties are defined as structures placed at the entrance of harbors or waterways within an estuary for the purpose of reducing entrance channel shoaling. Note that this category includes only jetties located wholly within the estuary and not coastal jetties located at the mouth of an estuary.

Objective

3. The overall objective of this investigation is to improve existing design guidance and develop new design guidance for the use of training structures in estuaries to reduce shoaling in navigation channels and basins.

4. The objective of this report is to identify, describe, and categorize the existing estuarine training structures. This inventory will provide the basis for the more detailed evaluation on the effectiveness of selected structures in reducing maintenance dredging requirements, to be documented in future reports.

Approach

5. The overall investigation consists of three tasks. The first task consists of identifying and classifying the existing estuarine training structures. The second task is to determine past and present design techniques for training structures and assess existing structure performance in specific cases. The third task will assess the applicability of modeling techniques, both physical and numerical, to estuarine training structure design and use appropriate testing to develop improved design guidance.

PART II: LISTING AND CLASSIFICATION OF STRUCTURES

6. This listing provides locations and classifications of estuarine training structures within the US Army Corps of Engineers Divisions and Districts. (No estuarine training structures were identified within the Los Angeles District nor the Pacific Ocean Division.) The information given with each structure is the District Project Map description, the approximate location, and the classification based on the four categories described in Part I of this report: lateral dike, longitudinal dike, jetty, or barrier dike.

(Note: The alphanumeric designation in parentheses under the Approximate Location column corresponds to the site designation included in Part III of this inventory.)

Estuary	Project Map Description	Approximate Location	Classification*
		New England Division	
Kennebec River Estuary, Maine	Beef Rock Training Wall	Mile 23 (1a.1)	Longitudinal dike
	Training wall	Mile 31 (1a.2)	Lateral dike
	Jetties	Richmond Harbor (1a.3)	Lateral dikes (2)
Royal River, Maine	Jetty	Mile 1 (1b)	Lateral dike
Saco River, Maine	Entrance jetty	Mile 0 (1c.1)	Jetty
	Chase Point jetty	Mile 3 (1c.2)	Lateral dike
	Junkins Point jetties	Mile 5 (1c.3)	Lateral dikes (2)
Massachusetts Bay, Mass.	Jetties	Scituate Bay (1d)	Jetties (2)
Cape Cod Bay, Mass.	Long Beach Dike	Plymouth Harbor (1e)	Longitudinal dike
Westport River, Mass.	Longitudinal training dike	Lions Tongue, Great Flat (1f)	Longitudinal dike

* Numbers in parentheses indicate number of structures at location.

(Continued)

Estuary	Project Map Description	Approximate Location	Classification
	New England Division (Continued)		
Thames River, Conn.	Mohegan Dike	Mile 9 (1g.1)	Longitudinal dike
	Trading Cove Dike	Mile 9.5 (1g.2)	Longitudinal dike
	Long Rock Dike	Mile 10 (1g.3)	Longitudinal dike
	Rolling Mill Dike	Mile 10 (1g.4)	Longitudinal dike
	Norwich Dike	Mile 10.5 (1g.5)	Longitudinal dike
Connecticut River below Hartford, Conn.	Hartford Training Wall	Mile 51 (1h.1)	Longitudinal dike
	Dikes	Mile 43 (1h.2)	Lateral dikes (8)
	Dikes	Mile 45 (1h.2)	Lateral dikes (5)
	Hurdles	Mile 45 (1h.2)	Lateral dikes (6)
	Dikes	Mile 46 (1h.2)	Lateral dikes (8)
	Hurdles	Mile 47 (1h.2)	Lateral dikes (4)
	Dikes	Mile 48 (1h.2)	Lateral dikes (8)
	Dike	Mile 49 (1h.2)	Longitudinal dike
	Hurdles	Mile 49 (1h.2)	Lateral dikes (4)
	Glastonbury Wing Dam	Mile 42 (1h.3)	Longitudinal dike
	Submerged dike	Mile 36 (1h.4)	Lateral dike
	Portland Bar Dike	Mile 33 (1h.5)	Lateral dike
	Sears Shoal Dike	Mile 24.5 (1h.6)	Longitudinal dike
New Haven Harbor, Conn.	Pile and riprap dike	Mile 3 (1i)	Longitudinal dike

(Continued)

Estuary	Project Map Description	Approximate Location	Classification
		New England Division (Continued)	
Milford Harbor, Conn.	Jetties	Mouth of Wepawaug River (1j)	Jetties
Housatonic River, Conn.	Dike	Mile 2 (1k.1)	Longitudinal dike
	Jetty	Mile 13 (1k.2)	Lateral dike
Southport Harbor, Conn.	Dike	Mill River (1l)	Longitudinal dike
Bullocks Point Cove, R. I.	Dike and jetty	Mouth of Bullocks Point Cove (1m)	Jetty
		North Atlantic Division	
New York District			
Flushing Bay and Creek, N. Y.	US Dike	Proximity of LaGuardia Airport, Long Island (2a)	Longitudinal dike
Browns Creek, Great South Bay, N. Y.	Jetties	Mouth (2b)	Jetties (2)
Hudson River, N. Y.	Dike	Near mile 1, Wappinger Creek (2c.1)	Longitudinal dike
	Dikes	Mouth of Esopus Creek (2c.2)	Jetties (2)
	Dikes	Mouth and entrance of Rondout Harbor (2c.2)	Jetties (2)
	Fordham Point Dike	Mile 122 (2c.3)	Longitudinal dike
	Stuyvestant Island Dike	Mile 127 (2c.4)	Longitudinal dike
	Bronks Dike	Mile 128 (2c.5)	Longitudinal dike
	New Baltimore Dike	Mile 131 (2c.6)	Longitudinal dike
	Mulls Island Half Dike	Mile 132 (2c.7)	Longitudinal dike
	Mulls Platt Half Dike	Mile 132 (2c.8)	Longitudinal dike

(Continued)

Estuary	Project Map Description	Approximate Location	Classification
	North Atlantic Division (Continued)		
New York District (Cont'd)			
Hudson River, N. Y. (Cont'd)	Coeymans Middle Dike	Mile 132 (2c.9)	Longitudinal dike
	Mulls Timber Dike	Mile 134 (2c.10)	Longitudinal dike
	New York State-maintained dike (Castleton dike)**	Mile 136 (2c.11)	Longitudinal dike
	Cedar Hill Dike	Mile 136 (2c.12)	Longitudinal dike
	Cow Island Dike	Opposite the previous dike (2c.13)	Longitudinal dike
	Winnies Dike	Mile 138 (2c.14)	Longitudinal dike
	Campbell Island Dike	Opposite the previous dike (2c.15)	Longitudinal dike
	Van Wies Dike	Mile 139 (2c.16)	Longitudinal dike
	Overslaugh Dike No. 2	Mile 140 (2c.17)	Longitudinal dike
	Beacon Island Dike	Mile 141 (2c.18)	Longitudinal dike
	Overslaugh Dike No. 1	Mile 141 (2c.19)	Longitudinal dike
	Papscanee Dike	Mile 141 (2c.20)	Longitudinal dike
	Bogart Island Dike	Mile 142 (2c.21)	Longitudinal dike
	Lower Patroon Island Dike	Mile 146 (2c.22)	Longitudinal dike
	Upper Patroon Island Dike	Mile 147 (2c.23)	Longitudinal dike
	Base Island Dike	Mile 147 (2c.24)	Longitudinal dike

(Continued)

** Not included in the inventory but listed for clarity.

Estuary	Project Map Description	Approximate Location	Classification
	North Atlantic Divison (Continued)		
New York District (Cont'd)			
Hudson River, N. Y. (Cont'd)	High Dike	Mile 147 (2c.25)	Longitudinal dike
	Breaker Island Dike	Mile 148 (2c.26)	Longitudinal dike
	Port Schuyler Dike	Mile 149 (2c.27)	Longitudinal dike
New York and New Jersey channels	US Dike	Mile 24 (2d)	Longitudinal dike
Raritan River, N. J.	US Dike	Mile 5 (2e)	Longitudinal dike
Cheesequake Creek, N. J.	Jetties	Mouth (2f)	Jetties (2)
	Dike	Mouth (2f)	Longitudinal dike
Shoal Harbor and Compton Creek, N. J.	Dike	Mouth (2g)	Longitudinal dike
Sandy Hook Bay, N. J.	Jetty	Small boat harbor entrance (2h)	Jetty
Shrewsbury River, N. J.	Dike	Barley Point near Normandie (2i)	Longitudinal dike
Philadelphia District			
Wilmington Harbor, Del.	Jetties	Mouths of the Christina and Brandywine Rivers (3a)	Jetties (3)
Inland Waterway, Delaware River to Chesapeake Bay, C & D Canal, Del.	Jetties	Delaware River entrance (3b)	Jetties (2)
Smyrna River, Del.	Jetties	Mouth (3c)	Jetties (2)
Mispillion River, Del.	Jetties	Mouth (3e)	Jetties (2)

(Continued)

Estuary	Project Map Description	Approximate Location	Classification
	North Atlantic Division (Continued)		
Philadelphia District (Cont'd)			
Inland Waterway, Rehoboth Bay to Delaware Bay, Del.	Jetties	Entrances at Rehoboth and Delaware Bays (3f)	Jetties (4)
Mantua Creek, N. J.	Jetties	Mouth (3g)	Jetties (2)
Raccoon Creek, N. J.	Jetty	Mouth (3h)	Jetty
Goshen Creek, N. J.	Jetties	Mouth (3i)	Jetties (2)
Neshaminy State Park Harbor, Pa.	Jetty	Entrance (3j)	Jetty
Delaware River, Philadelphia, Pa., to the sea	Fisher Point Dike	Petty Island (Camden, N. J.) (3k.1)	Longitudinal dike
	Howell Cove Dike	Near Big Timber Creek (N. J.) (3k.2)	Longitudinal dike
	Mifflin Bar Dike	Near airport (Philadelphia, Pa.) (3k.3)	Longitudinal dike
	Chester Island Dike	Chester Island (3k.4)	Lateral dike
	Oldmans Point Dike	North of Pennsgrove, N. J. (3k.5)	Lateral dike
	Pennsville Dike	South of Twin Delaware Memorial Bridges (3k.6)	Longitudinal dike
	Pea Patch Island Dike	Pea Patch Island (3k.7)	Longitudinal dike
	Bulkhead Bar Dike	East of the Pea Patch Island Dike (3k.8)	Longitudinal dike
	Killcohook Dike	East of the Pea Patch Island Dike (3k.9)	Longitudinal dike
	Reedy Island Dike	Reedy Island (3k.10)	Longitudinal dike
	Alloway Creek Dike	Alloway Creek, N. J. (3k.11)	Lateral dike

(Continued)

Estuary	Project Map Description	Approximate Location	Classification
	North Atlantic Division (Continued)		
Philadelphia District (Cont'd)			
Delaware River, Philadelphia, Pa., to the sea (Cont'd)	Stony Point Dike	South of Alloway Creek, N. J. (3k.12)	Longitudinal dike
	Hope Creek Dike	Below Stony Point (3k.13)	Lateral dike
Double Creek, N. J.	Jetty	Barnegat Bay entrance (31)	Jetty
New Jersey Intracoastal Waterway, Cape May Canal	Jetties	Cape May Canal entrance (3m)	Jetties (2)
Baltimore District			
Claiborne Harbor, Md.	Jetty	Eastern Bay (4b)	Jetty
Bivalve, Md.	Jetties	Nanticoke River (4c)	Jetties (2)
Nanticoke, Md.	Jetties	Nanticoke River (4d)	Jetties (2)
Twitch Cove and Big Thorofare River, Md.	Jetties	Smith Island, east Chesapeake Bay (4e)	Jetties (2)
Fishing Creek, Chesapeake Beach, Md.	Jetties	Chesapeake Beach (4g)	Jetties (2)
Back Creek, Md.	Jetty	Eastport (Chesapeake Bay) (4j)	Jetty
Herring Creek, Md.	Jetties	Tall Timbers (Potomac River) (4k)	Jetties (2)
Little Wicomico River, Va.	Jetties	Potomac River and Chesapeake Bay (41)	Jetties (2)
Bonum Creek, Va.	Jetties	Tucker Hill (Potomac River) Bay (4m)	Jetties (2)
Nomini Creek, Va.	Jetty	Nomini Bay (4n)	Jetty

(Continued)

Estuary	Project Map Description	Approximate Location	Classification
	North Atlantic Division (Continued)		
Norfolk District			
James River, Va.	Spur and training dikes	Between miles 75 and 90 (5a)	Longitudinal and lateral dikes
Rappahannock River, Va.	Dikes (crib and pile, riprap stone)	Between miles 90 and 110 (5b)	Longitudinal and lateral dikes
Carters Creek, Va.	Jetty	Rappahannock River (5d)	Jetty
Urbanna Creek, Va.	Jetties	Rappahannock River (5e)	Jetties (2)
Milford Haven, Va.	Jetty	Hills Bay (5f)	Jetty
York River, Va.	Dike	Mile 32, West Point Bar (5g)	Longitudinal dike
Little River (Creek), Va.	Jetties	Norfolk and Virginia Beach (5h)	Jetties (2)
Tylers Beach, Va.	Jetties	Burwells Bay (5i)	Jetties (2)
Cape Charles City Harbor, Va.	Jetty	Chesapeake Bay (5k)	Jetty
Appomattox River, Va.	Levee	About 1 mile east of dam at Petersburg (5l)	Barrier dike
	South Atlantic Division		
Wilmington District			
Silver Lake Harbor, N. C.	Training wall	On Ocracoke Island (6a)	Jetty
Cedar Island Bay, N. C.	Jetties	Cedar Island Refuge (6b)	Jetties (2)
Beaufort Harbor, N. C.	Training wall	South tip of Radio Island (6c)	Longitudinal dike

(Continued)

Estuary	Project Map Description	Approximate Location	Classification
	South Atlantic Division (Continued)		
Charleston District			
Charleston Harbor, S. C.	Dikes	Cooper River north of Drum Island (7a)	Lateral dikes (2)
Georgetown Harbor, S. C.	Training wall	Winyah Bay (7b)	Longitudinal dike
Savannah District			
Savannah Harbor, Ga.	Tide gate	Savannah River (8a)	Barrier dike
Brunswick Harbor, Ga.	Jetty	Brunswick River (8b)	Jetty
Savannah River, Ga.	Dikes	Miles 27.5 and 30.5 (8c)	Longitudinal and lateral dikes (?)
Jacksonville District			
Jacksonville Harbor, Fla.	Training walls	St. Johns River (9a)	Longitudinal dikes (7)
Coral Gables Waterway, Miami Harbor, Fla.	Jetty	Biscayne Bay (9b)	Jetty
Mobile District			
Fly Creek, Fairhope, Ala.	Jetties	Fly Creek and Mobile Bay (10a)	Jetties (2)
Dauphin Island Bay, Ala.	Jetty	Dauphin Island in Mobile Bay (10b)	Jetty
	Lower Mississippi Valley Division		
New Orleans District			
Mississippi River, La.	Sills	Head of Passes region (11a)	Barrier dikes (2)
	Dikes	North of Head of Passes (11a)	Lateral dikes (4)
	Headland structures	Head of Passes (11a)	Longitudinal dikes (2)

(Continued)

Estuary	Project Map Description	Approximate Location	Classification
Lower Mississippi Valley Division (Continued)			
New Orleans District (Cont'd)			
Mississippi River, La. (Cont'd)	Spur dikes	Southwest Pass (11a)	Lateral dikes (129)
Southwestern Division			
Galveston District			
Port O'Connor, Tex.	Dikes	Matagorda Bay (12a)	Jetties (2)
Texas City Dike, Texas City, Tex.	Dike	Galveston Bay (12d)	Barrier dike
Port Bolivar, Tex.	Dike	Galveston Bay (12e)	Jetty
Trinity Bay (Channel to Liberty near Double Bayou, Tex.)	Earth dam	Channel to Liberty (12f)	Barrier dike
Cedar Bayou, Tex.	Submerged jetties	Near Houston Point in Galveston Bay (12g)	Jetties (2)
South Pacific Division			
San Francisco District			
Napa River, Calif.	Dikes	Mile 0 to mile 16 (13a)	Jetties (2) and lateral dikes
	Dike	Upper San Pablo Bay (13a)	Longitudinal dike
Richmond Harbor, San Francisco Bay, Calif.	Training wall	Outer harbor (13b)	Longitudinal dike
Oakland Harbor, San Francisco Bay, Calif.	Jetties	Inner harbor entrance (13c)	Jetties (2)
Humboldt Harbor and Bay, Calif.	Groin and breakwater	Buhne Point (13d)	Barrier dike
Noyo River and Harbor, Calif.	Jetties and walls	Noyo (13e)	Jetties

(Continued)

Estuary	Project Map Description	Approximate Location	Classification
		North Pacific Division	
Portland District			
Columbia River, Oreg.	Dikes	Oregon Slough, Mile 102 (14a.1)	Lateral dikes (9)
	Dikes	Lower Columbia River, mile 0 to mile 145 (14a.2)	Lateral dikes (165)
Yaquina River near Toledo, Oreg.	Submerged dikes	Miles 11 and 13.5 (14b)	Lateral dikes (2)
Umpqua River, Oreg.	Training jetty	Mouth (14c)	Longitudinal dike
Coos Bay, Oreg.	Dikes	Mile 6 (14d)	Lateral dikes (5)
Baker Bay, Oreg.	Dikes	West of Sand Island (14e)	Lateral dikes (4)
Seattle District			
Swinomish Channel, Wash.	Jetties and dikes	Mouth (15a)	Longitudinal dikes (2), and barrier dikes (4)
Skagit River, Wash.	Training dike	Skagit Bay (15b)	Longitudinal dike
	Closing dikes	Skagit River (15b)	Barrier dikes (6)
Snohomish River, Everett Harbor, Wash.	Training dikes, spur dikes, and pile wall	Everett Harbor (15c)	Longitudinal dikes (3), and lateral dikes (2)
Puyallup River, Tacoma Harbor, Wash.	Training walls	Tacoma Harbor (15d)	Jetties (2)
Quillayute River, Wash.	Dike and training wall	Near mouth (15e)	Longitudinal dikes (2)
Grays Harbor, Point Chehalis, Oreg.	Groins	Point Chehalis (15f)	Lateral dikes (6)

(Continued)

Estuary	Project Map Description	Approximate Location	Classification
	North Pacific Division (Continued)		
Alaska District			
Cordova Harbor, Alaska	Silt barrier	Orca Inlet (16a)	Barrier dike
Dillingham Harbor, Alaska	Submerged rock sill	Bristol Bay (16b)	Barrier dike
Hoonah Harbor, Alaska	Diversion dike	Chichagof Island (16c)	Lateral dike

PART III: BRIEF TRAINING STRUCTURE DESCRIPTIONS

7. In this section, brief descriptions of the training structures listed in Part II are given. Included in the descriptions are characteristics of the structures themselves as well as the hydraulic environment in which they have been constructed. Dimensions of features are included when available from project maps. Each structure is listed according to the District Project Map descriptor, with the classification category following in parentheses. Below each description, the appropriate National Oceanic and Atmospheric Administration, National Ocean Service (NOAA/NOS), Nautical Chart number is given for further reference. Since the initial inventory compilation, several structures and/or locations have been noted as inactive or constructed and maintained by other interests. Because these structures/ locations are still listed in some of the project maps, they are also included in this text but are noted as being disqualified from the inventory.

New England Division

8. The New England Division, which is not divided into Districts, has over 60 estuarine training structures within the Division's jurisdiction (US Army Engineer Division, New England, 1980, 1982). The structures include jetties, dikes, and training walls, and the project sites are located in Figure 1.

Kennebec River Estuary, Maine

9. Site 1a.1, Beef Rock Training Wall (longitudinal dike). The Beef Rock Training Wall, a longitudinal wall approximately 4,000 ft* long, is adjacent to the east channel at Swan Island, river mile 23 (Figure 2). The project provides for a navigation channel at Beef Rock Shoal 150 ft wide and 17 ft deep. The mean range of tide is approximately 5.3 ft.

(NOAA Nautical Chart No. 13298)

10. Site 1a.2, training wall (lateral dike). The navigation project includes a training wall north of Sands Island near river mile 31 as indicated

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* A table of factors for converting non-SI units of measurement to SI (metric) units is found on page 3.

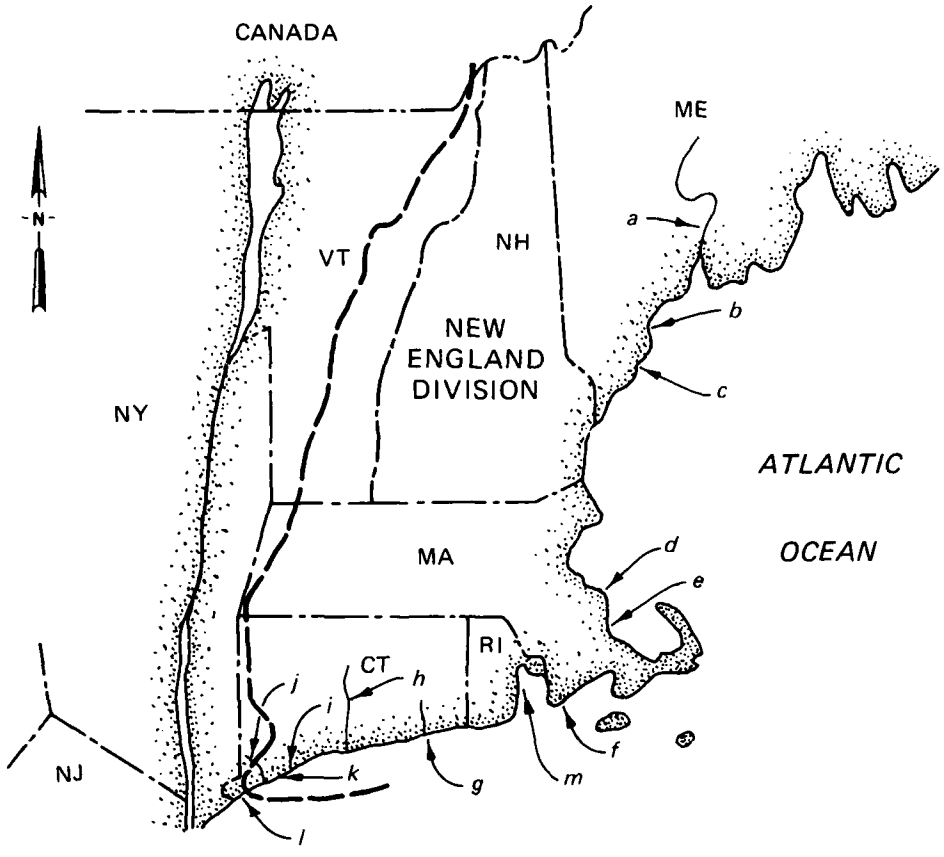

Figure 1. Location Plan 1, New England Division

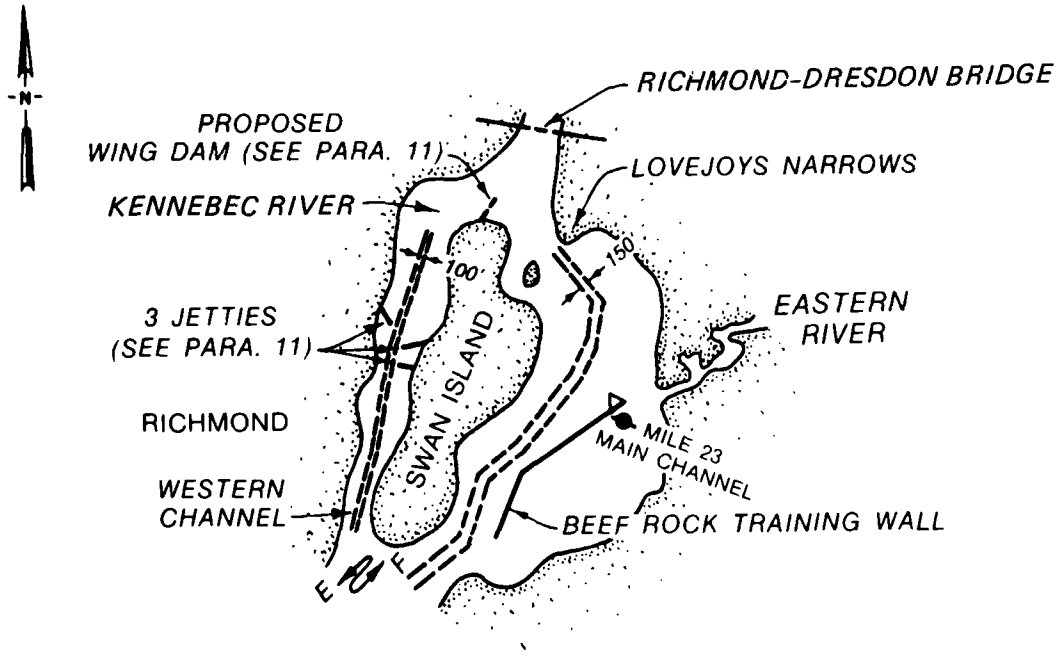

Figure 2. Beef Rock Training Wall and Richmond Harbor structures

in Figure 3. The project provides for a navigation channel that is 150 ft wide and 18 ft deep. The mean range of tide is approximately 5.1 ft.

(NOAA Nautical Chart No. 13298)

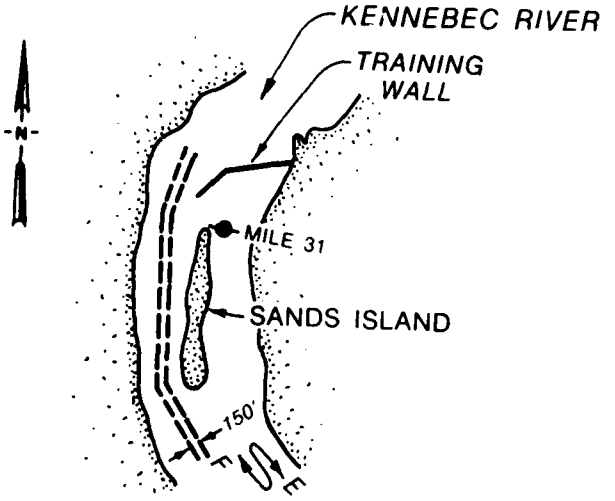

Figure 3. Kennebec River training wall, river mile 31

11. Site 1a.3, jetties (lateral dikes). Three jetties that function as dikes were constructed at Richmond Harbor, Maine, in the western channel of the Kennebec River on the west side of Swan Island (Figure 2). A wing dam was recommended to prevent shoaling at the upper end of Swan Island (Figure 2). However, the western channel was recommended for abandonment in 1917. The project was completed in 1883 and provides for a navigation channel 10 ft deep. The mean range of tide is 5.3 ft.

(NOAA Nautical Chart No. 13298)

Royal River Estuary, Maine

12. Site 1b, jetty (lateral dike). The navigation project includes the construction of a rubblestone jetty, the "Federal jetty," 195 ft long, opposite Wolfe's Point near river mile 1 (Figure 4). The project provides for a navigation channel 100 ft wide and 4.5 ft deep. The mean range of tide is approximately 9 ft.

(NOAA Nautical Chart No. 13292)

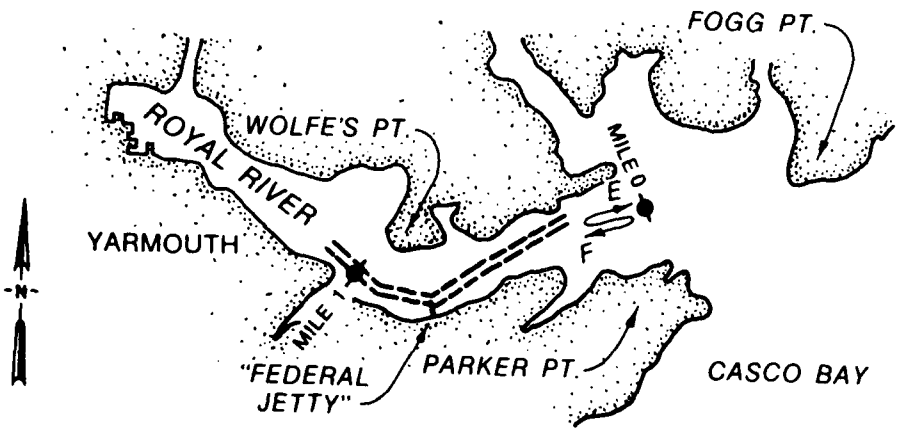

Figure 4. Jetty near Wolfe's Point, Royal River estuary

Saco River Estuary, Maine

13. Several structures were constructed in this estuary, including the following:

a. Site 1c.1, entrance jetty. The jetty is located at the river mouth and projects easterly into Saco Bay (Figure 5). The jetty (south side) is about 4,800 ft long. An approximately parallel breakwater, located on the north side of the channel, is about 6,600 ft long. Also, a short dike protects the landward breakwater connection. The project provides for a navigation channel 8 ft deep and 200 ft wide. The mean range of tide is about 8.8 ft.

b. Site 1c.2, Chase Point jetty (lateral dike). As shown in Figure 5.

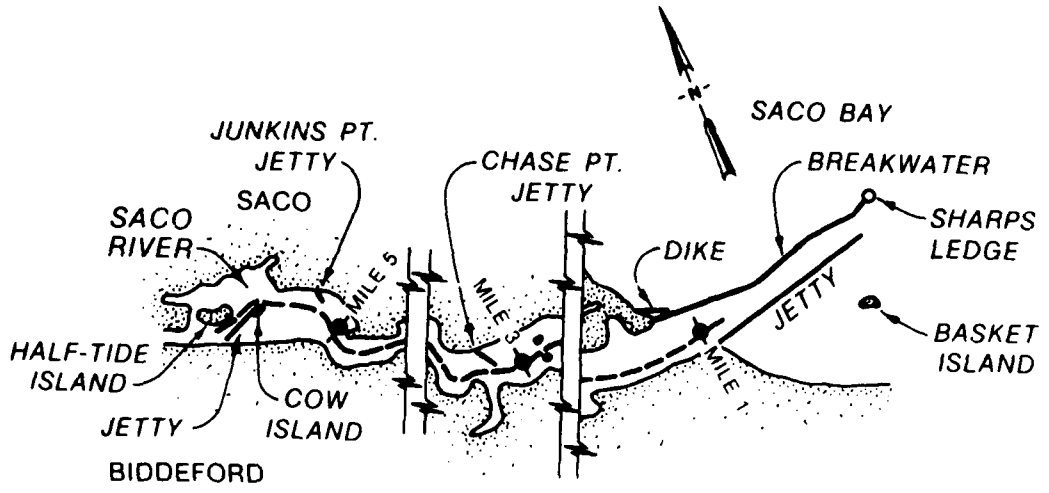

Figure 5. Saco River estuarine jetties

c. Site 1c.3, Junkins Point jetties (lateral dikes). As shown in Figure 5.

(NOAA Nautical Chart No. 13298)

Massachusetts Bay, Massachusetts

14. Site 1d, rubble-mound entrance jetties (jetties). The north rubble-mound jetty projects about 400 ft to the southeast and about 300 ft to the east into Massachusetts Bay (Figure 6). The Commonwealth of Massachusetts constructed a rubble breakwater within the harbor very close to the jetty. The south jetty projects about 300 ft north toward the entrance channel where the navigation channel is 200 ft wide and 12 ft deep. The project was completed in 1959. The mean range of tide is 9.0 ft.

(NOAA Nautical Chart No. 13287)

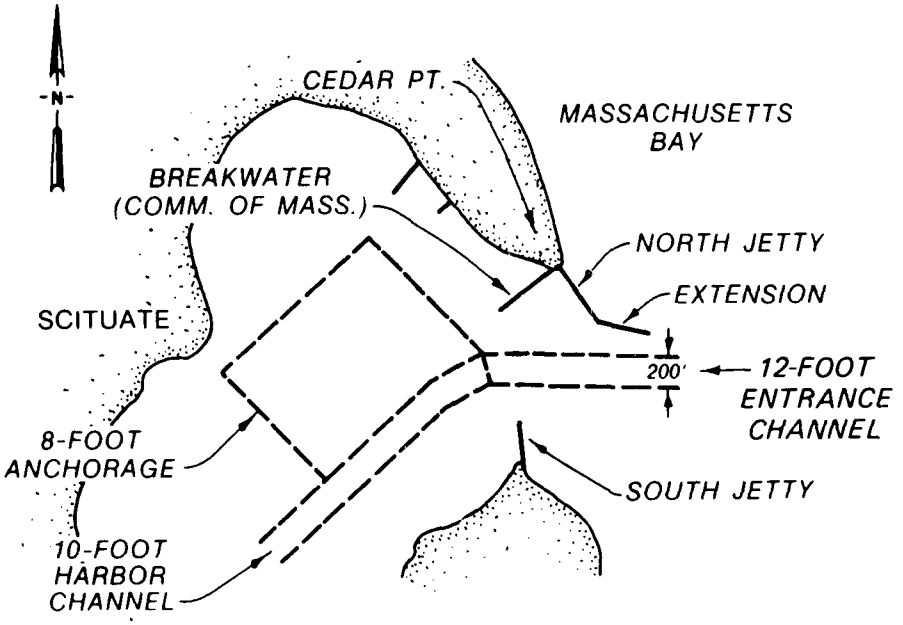

Figure 6. Scituate Harbor jetties

Cape Cod Bay, Massachusetts

15. Site 1e, Plymouth Harbor Dike at Long Beach (longitudinal dike). The navigation project includes a riprap-protected dike along Long Beach in Plymouth Bay (Figure 7). The navigation channel, which runs parallel with the

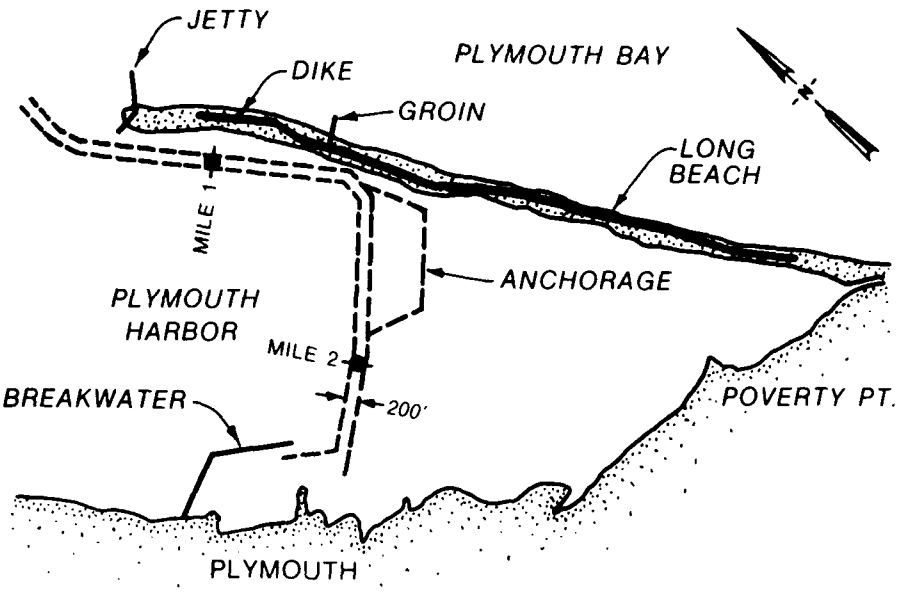

Figure 7. Plymouth Harbor dike at Long Beach

dike, is 200 ft wide and 18 ft deep. The mean range of tide is approximately 9.6 ft.

(NOAA Nautical Chart No. 13253)

Westport River, Massachusetts

16. Site 1f, longitudinal training dike (longitudin dike). The navigation project proposed a longitudinal training dike separating the channel, located in the East Branch, from the West Branch (Figure 8). The dike would be constructed from Great Flat and extend approximately 2,500 ft southwest to a shoaled area called Lions Tongue. Also, to the east of this area is a proposed dike from Bailey Flat to Horse Neck Point (Figure 8). The project channel is 200 ft wide and 12 ft deep. The mean range of tide is 3 ft.

(NOAA Nautical Chart No. 13228)

Thames River, Connecticut

17. Several structures were constructed in this estuary. Five training dikes with tops at mean high water are located between river miles 8 and 12. The adjacent navigation channel is 200 ft wide and 25 ft deep. The mean range of tide is 2.6 ft at New London.

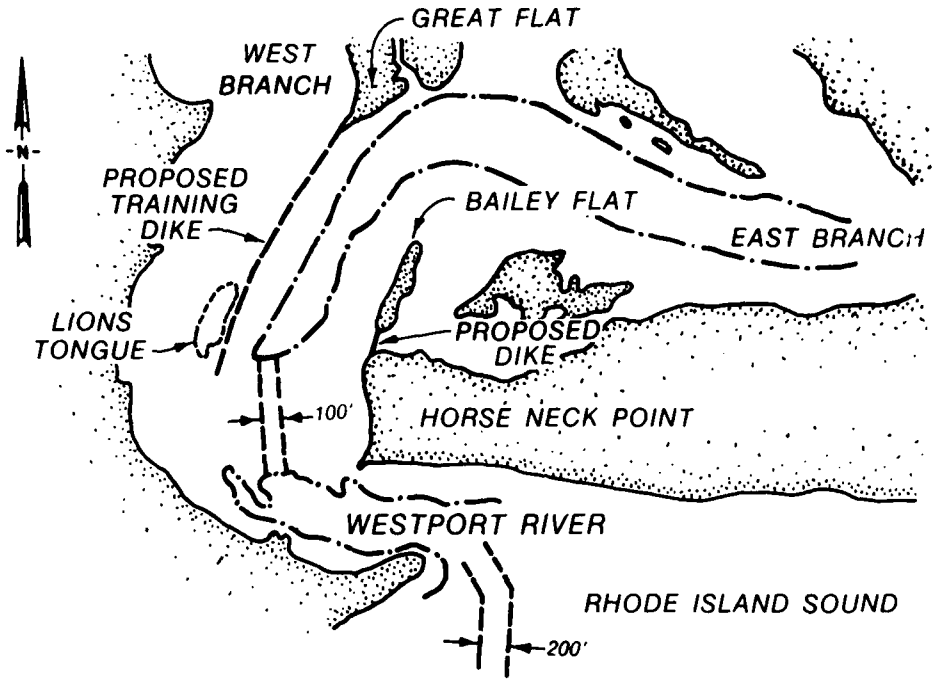

Figure 8. Westport River training dike

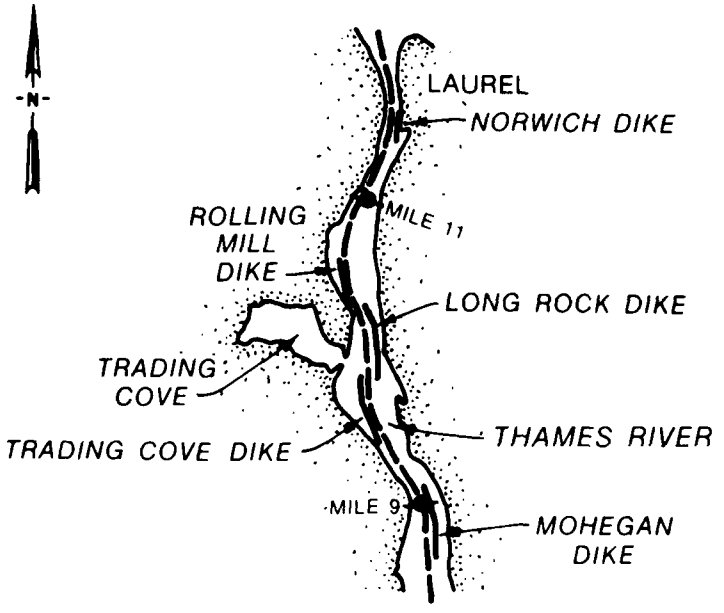

Figure 9. Thames River training walls

a. Site 1g.1, Mohegan Dike (longitudinal dike), 2,988 ft long, as shown in Figure 9.

b. Site 1g.2, Trading Cove Dike (longitudinal dike), 2,370 ft long, as shown in Figure 9.

c. Site 1g.3, Long Rock Dike (longitudinal dike), 2,800 ft long, as shown in Figure 9.

d. Site 1g.4, Rolling Mill Dike (longitudinal dike), 3,483 ft long, as shown in Figure 9.

e. Site 1g.5, Norwich Dike (longitudinal dike), 1,050 ft long, as shown in Figure 9.

(NOAA Nautical Chart No. 12372)

Connecticut River below
Hartford, Connecticut

18. Several structures were constructed in this estuary. At site 1h, various training structures are located in the navigation project between river miles 24 and 51 (Figure 10). The navigation channel is 150 ft wide and 15 ft deep. The mean range of tide averages 3.5 ft at the mouth and 1 ft at Hartford (low stage).

a. Site 1h.1, Hartford Training Wall (longitudinal dike). The dike is located on the west bank between river miles 50 and 51, at Hartford. The dike is about 3,700 ft long and is aligned parallel with the navigation channel.

b. Site 1h.2, dikes and hurdles (lateral dikes). Clusters of dikes and hurdles are indicated near river miles 43, 45, 46, 47, 48, and 49. The dikes and hurdles are relatively short and perpendicular to the channel. In several cases, hurdles (a type of spur or lateral dike) are indicated opposite a dike cluster.

c. Site 1h.3, Glastonbury Wing Dam (longitudinal dike).

d. Site 1h.4, submerged dike (lateral dike). The dike is located near mile 36. The dike projects about 900 ft east from the bank, and then about 700 ft south parallel with the west bank of Gildersleeve Island. The navigation channel parallels the island's east bank.

e. Site 1h.5, Portland Bar Dike (lateral dike).

f. Site 1h.6, Sears Shoal Dike (longitudinal dike). The dike, located near mile 24, projects about 1,800 ft south from Hurd Brook.

(NOAA Nautical Chart No. 12377)

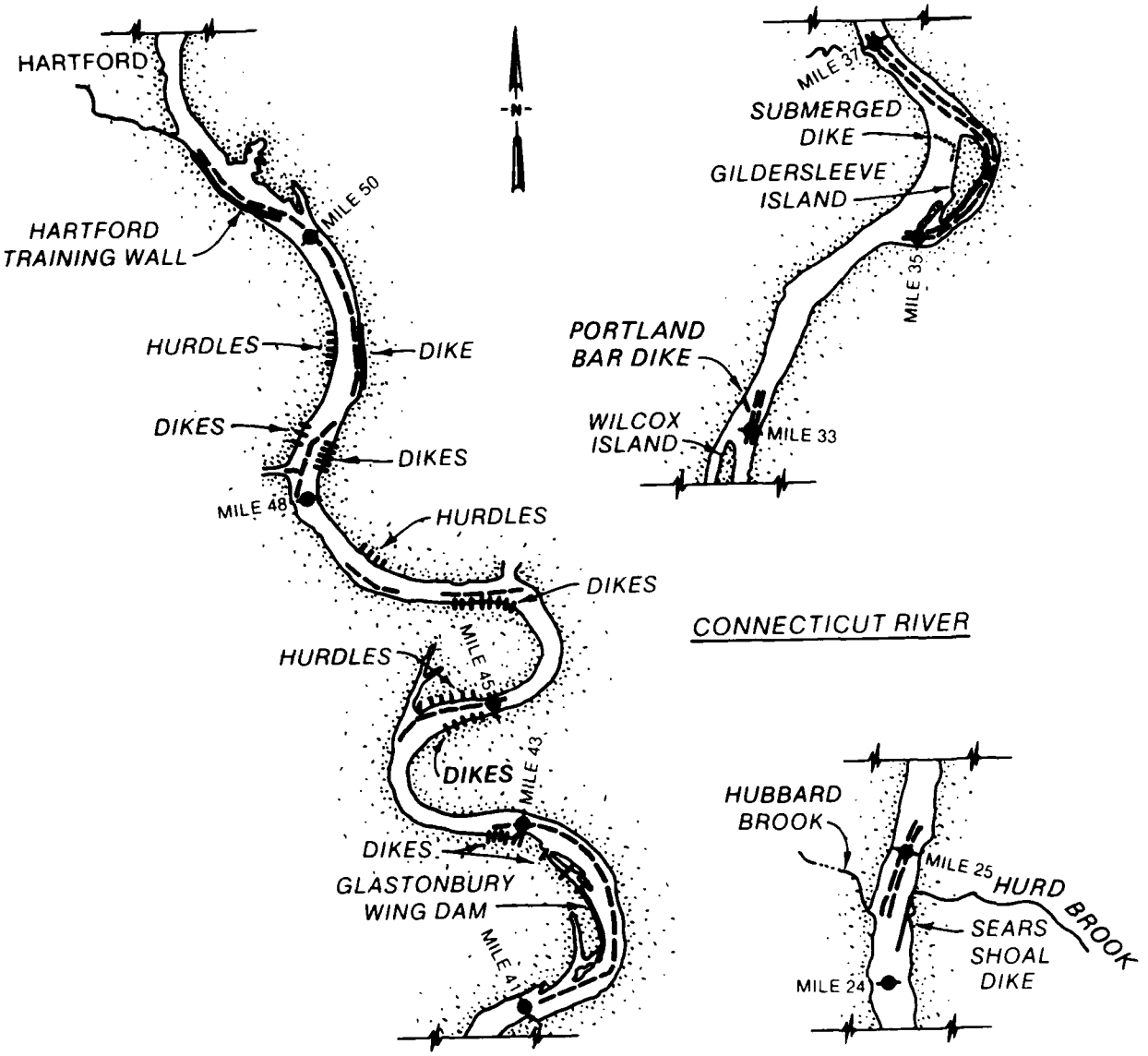

Figure 10. Connecticut River training structures

New Haven Harbor, Connecticut

19. Site 1i, pile and riprap dike (longitudinal dike). The navigation project includes a pile and riprap dike located at Sandy Point near mile 3 (Figure 11). The closure part of the dike is about 1,600 ft long, and extends in an easterly direction from Sandy Point to the main dike section, which itself extends about 2,400 ft parallel with the navigation channel in a southerly direction. The navigation channel is 400 ft wide and 35 ft deep. The mean range of tide is 6.2 ft.

(NOAA Nautical Chart No. 12371)

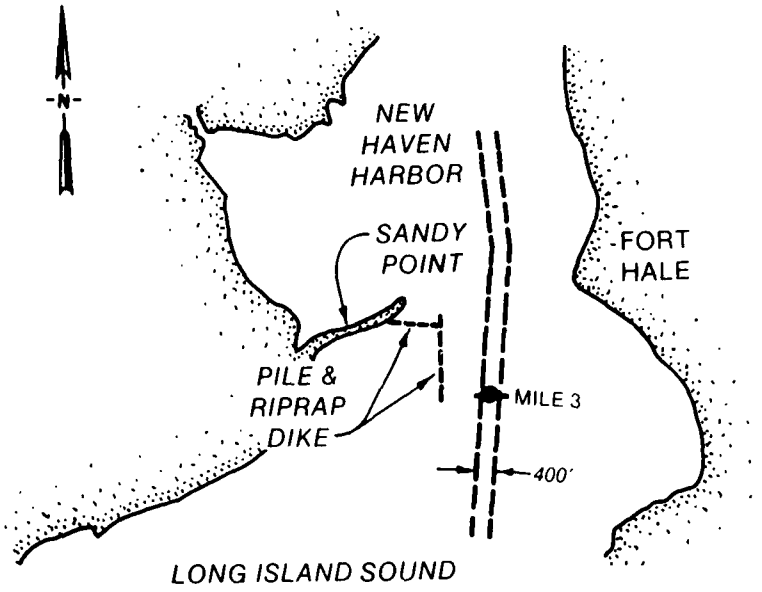

Figure 11. Longitudinal dike in New Haven Harbor

Milford Harbor, Connecticut

20. Site 1j, jetties. The navigation project includes two riprap jetties at the entrance to Wepawaug River (Figure 12). Burns Point Jetty is about 300 ft long and directed to the south, and Long Jetty is about 450 ft long and directed to the west. The project entrance channel is 100 ft wide and 10 ft deep. The mean range of tide is 6.6 ft.

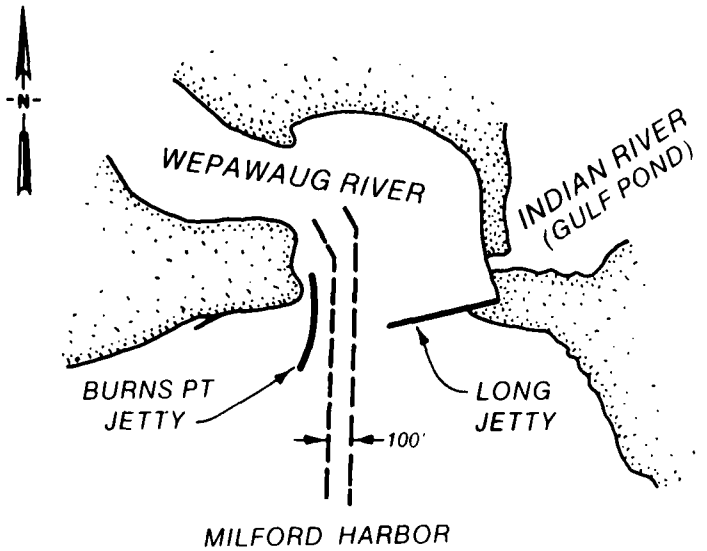

Figure 12. Milford Harbor jetties

Housatonic River, Connecticut

21. Two structures were constructed in this estuary:

a. Site 1k.1, dike (longitudinal dike). A riprap dike was constructed at Stratford near mile 2 (Figure 13). The project was limited to a length of 1,500 ft. The project navigation channel is 200 ft wide and 18 ft deep. The mean range of tide is about 5.5 ft.

b. Site 1k.2, jetty (lateral dike). A 163-ft-long riprap jetty that functions as a lateral dike was constructed near Sow and Pigs Rock, near mile 13 (Figure 13). The project navigation channel is 100 ft wide and 7 ft deep. The mean range of tide is about 5.0 ft.

(NOAA Nautical Chart No. 12370)

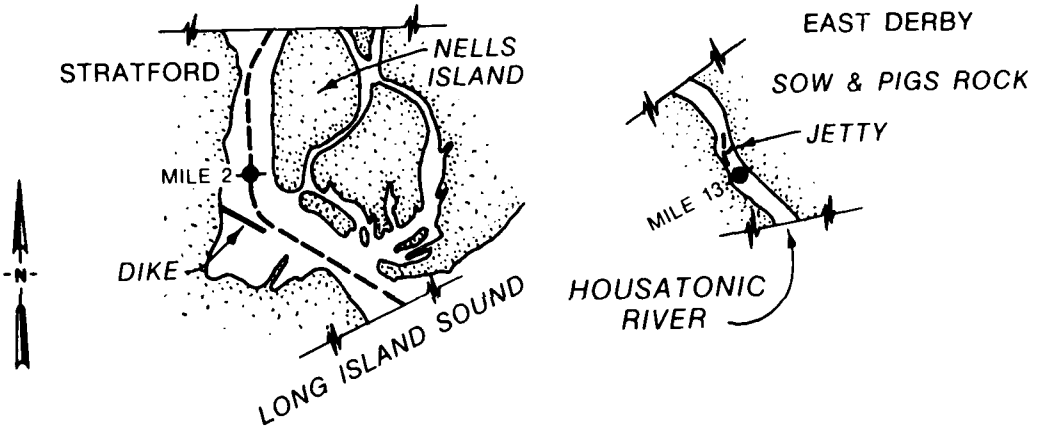

Figure 13. Training structures in the Housatonic estuary

Southport Harbor, Connecticut

22. Site 11, dike (longitudinal dike). The navigation project includes a longitudinal dike about 1,350 ft long on the east bank of Mill River (Figure 14). The project channel varies from 400 to 175 ft wide and is 9 ft deep. The mean range of tide is 6.9 ft.

(NOAA Nautical Chart No. 12369)

Bullocks Point Cove, Rhode Island

23. Site 1m, dike and jetty (jetty). The navigation project includes a rubblestone dike and jetty that were constructed to build the tip of Bullocks

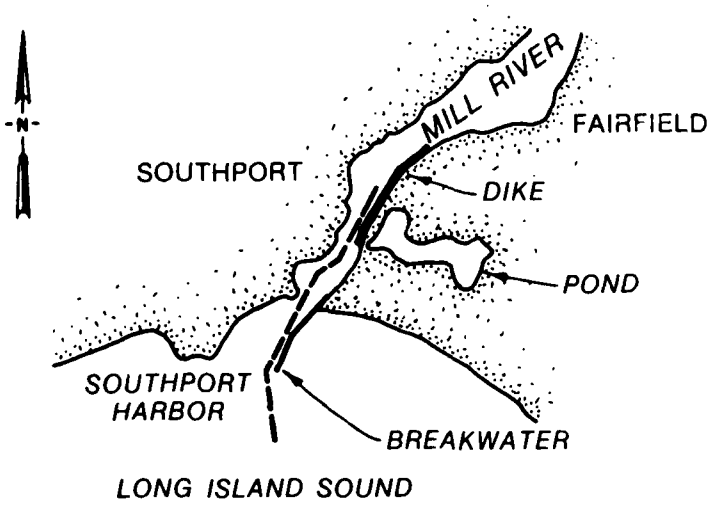

Figure 14. Longitudinal dike in the Mill River estuary

Point to a height of 9 ft above mean low water (Figure 15). The dike, which is about 350 ft long in an easterly direction, is connected to a jetty that extends about 250 ft in a southerly direction. The area between was back-filled with dredged sands, which was completed in 1959. The project channel is 75 ft wide and 8 ft deep. The mean range of tide is 4.6 ft.

(NOAA Nautical Chart No. 13224)

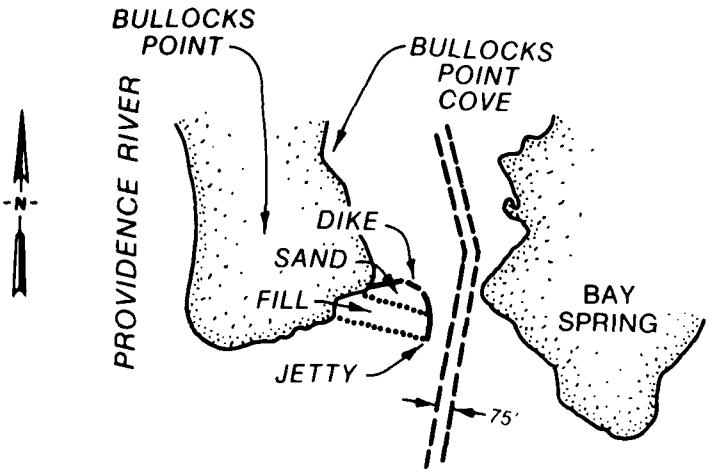

Figure 15. Training structures at Bullocks Point Cove

North Atlantic Division

New York District

24. About 40 training structures are located within the jurisdiction of the New York District (US Army Engineer District, New York, 1975). The structure types include dikes and jetties, and are located as indicated in Figure 16.

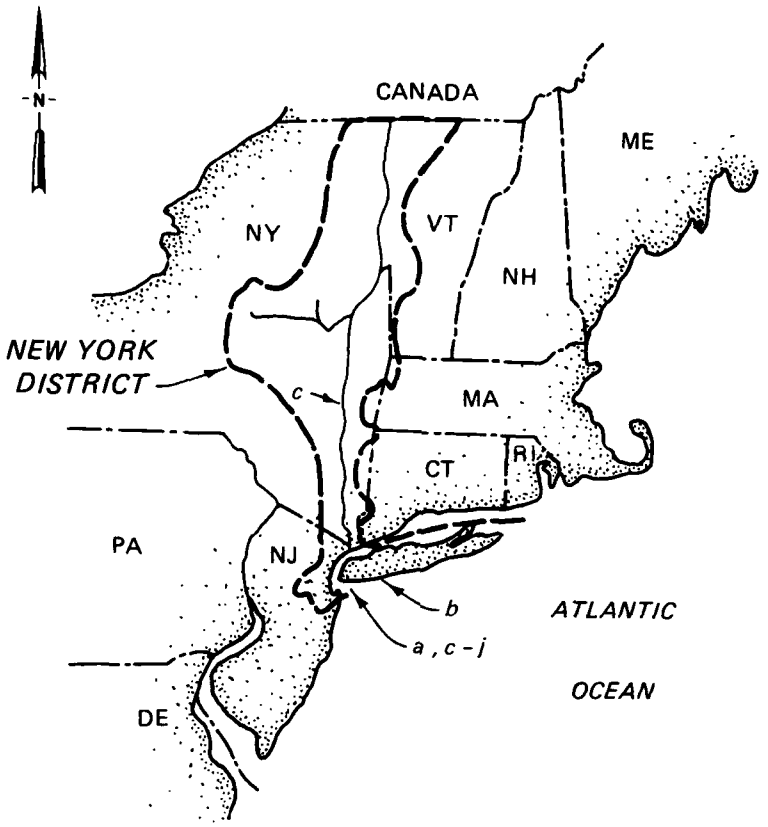

Figure 16. Location Plan 2, New York District

Flushing Bay and Creek, New York

25. Site 2a, dikes (longitudinal dikes). The two neighboring dikes are located in Flushing Bay, Queens, New York (Figure 17). An earth dike angles to the southeast from the approach area of LaGuardia Airport for about 2,400 ft and then extends almost due south for about 1,400 ft. The extension is listed as having riprap revetment. The second dike is adjacent and parallel to the channel and is labeled "US DIKE." The project channel depth in

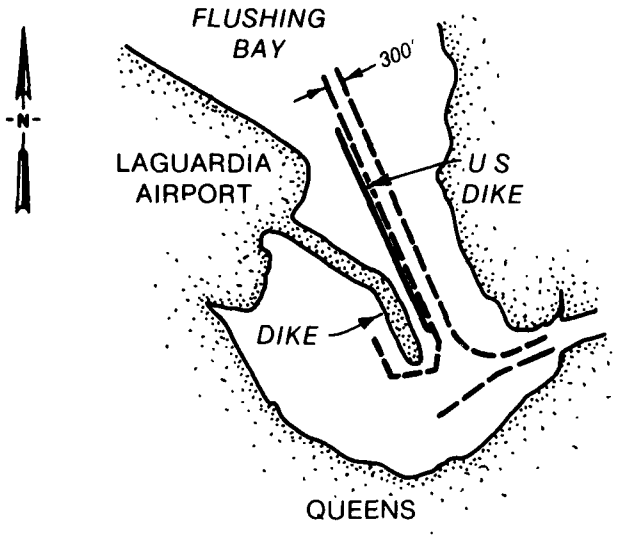

Figure 17. Dikes in Flushing Bay

this area is 15 ft and the width is 300 ft. The mean range of tide is 6.8 ft.

(NOAA Nautical Chart No. 12366)

Browns Creek, Great South Bay, New York

26. Site 2b, jetties. Two stone jetties extend into Great South Bay from the entrance of Browns Creek (south of Sayville) (Figure 18). The

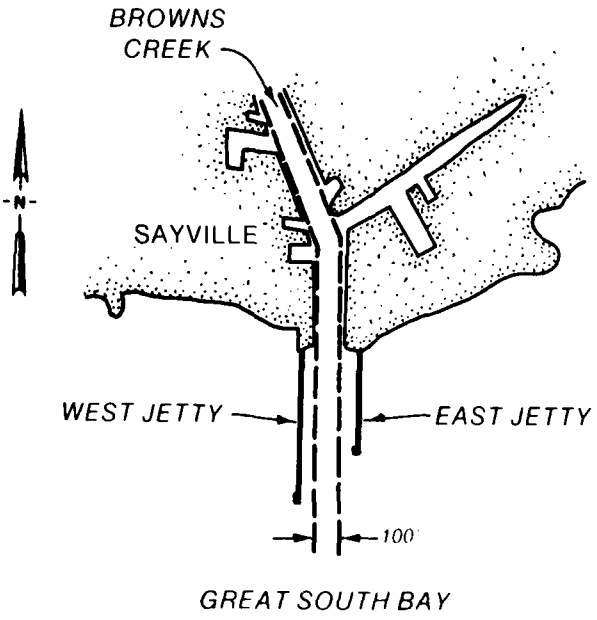

Figure 18. Stone jetties at Browns Creek

jetties are authorized to be 1,400 ft (east) and 1,600 ft (west) long. The project channel depth is 6 ft and the width is 100 ft. The mean range of tide is 0.7 ft.

(NOAA Nautical Chart No. 12352)

Hudson River, New York

27. Site 2c. The following structures are located along the Hudson River, and are indicated in Figures 19-21 as noted.

a. Site 2c.1, dike (longitudinal dike). The dike is located on Wappinger Creek (near mile 1), which is southwest of Wappinger Falls, New York (Figure 19). The structure is about 700 ft long and is adjacent and parallel to the navigation channel. The completed project channel depth is 8 ft and the width is 80 ft. The mean range of tide is 3 ft.

(NOAA Nautical Chart No. 12347)

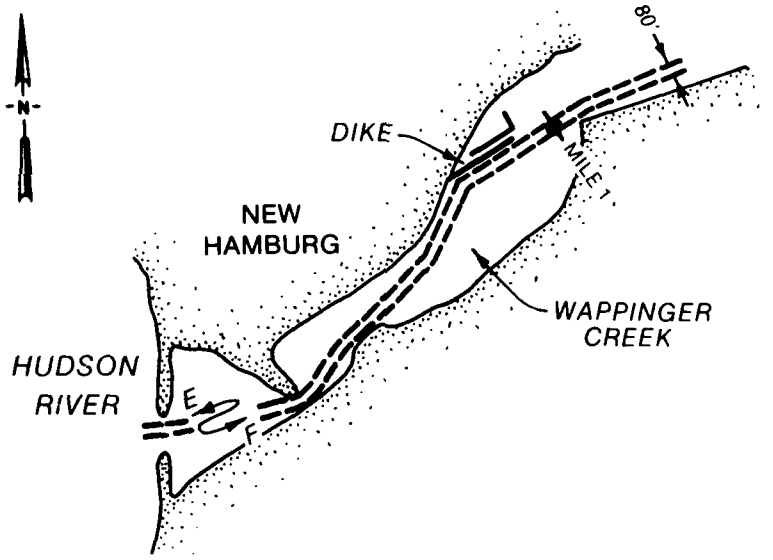

Figure 19. Dike at Wappinger Creek

b. Site 2c.2, dikes (jetties). Two dikes are located in Esopus Creek east of Saugerties (Figure 20). The completed harbor project includes the north and south dikes, which are each about 2,000 ft long and parallel to the bank, with the south dike extending into the Hudson River functioning as a jetty. The project channel is 12 ft deep and 200 ft wide. The mean range of tide is about 3.8 ft.

(NOAA Nautical Chart No. 12347)

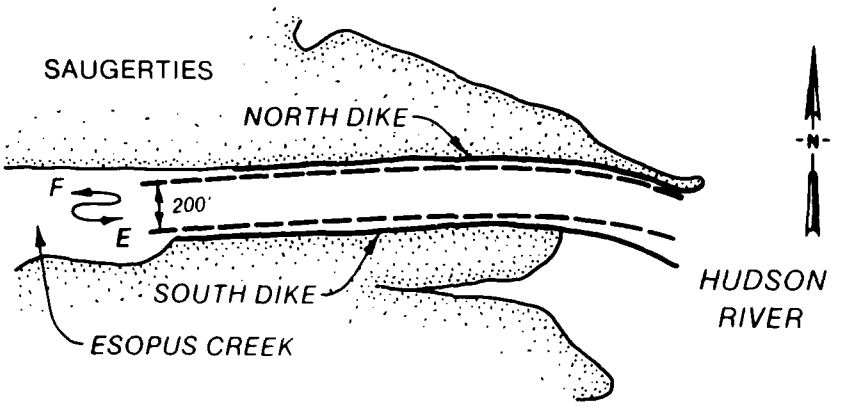

Figure 20. Dikes at Esopus Creek

c. Site 2c.2, dikes (jetties). Two dikes that function as jetties were constructed at the entrance of Rondout Harbor in the Hudson River (Figure 21). The parallel dikes are about 350 ft apart and 2,000 ft long. The north dike has a northerly branch about 800 ft long that functions as a longitudinal dike. The navigation channel at the entrance is 14 ft deep and 100 ft wide. The mean range of tide at Rhinecliff (south of Kingston) is about 3.7 ft.

(NOAA Nautical Chart No. 12347)

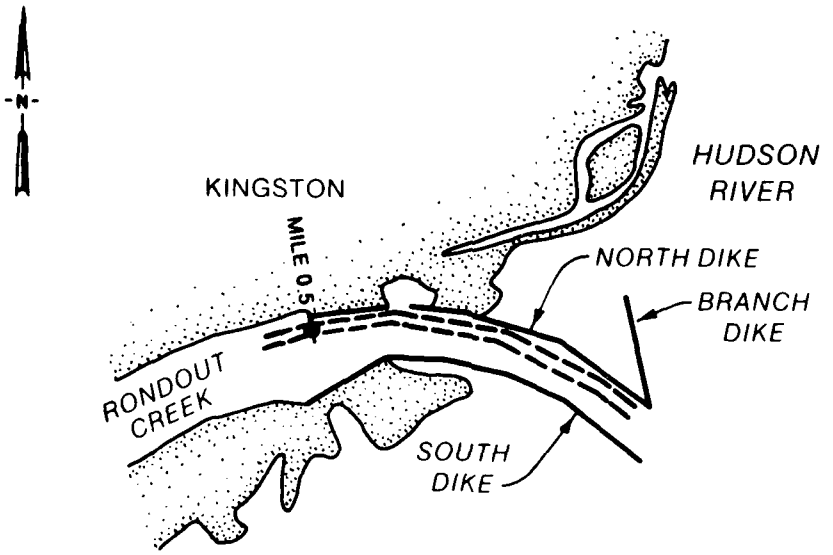

Figure 21. Dikes at the Rondout Harbor entrance

28. The following is a listing of structures that are located in the Hudson River estuary between New York City and Waterford (Figure 22). The federal navigation channel begins at New York City (600 ft wide and 32 ft deep) and ends at Waterford (200 ft wide and 14 ft deep), which is a distance

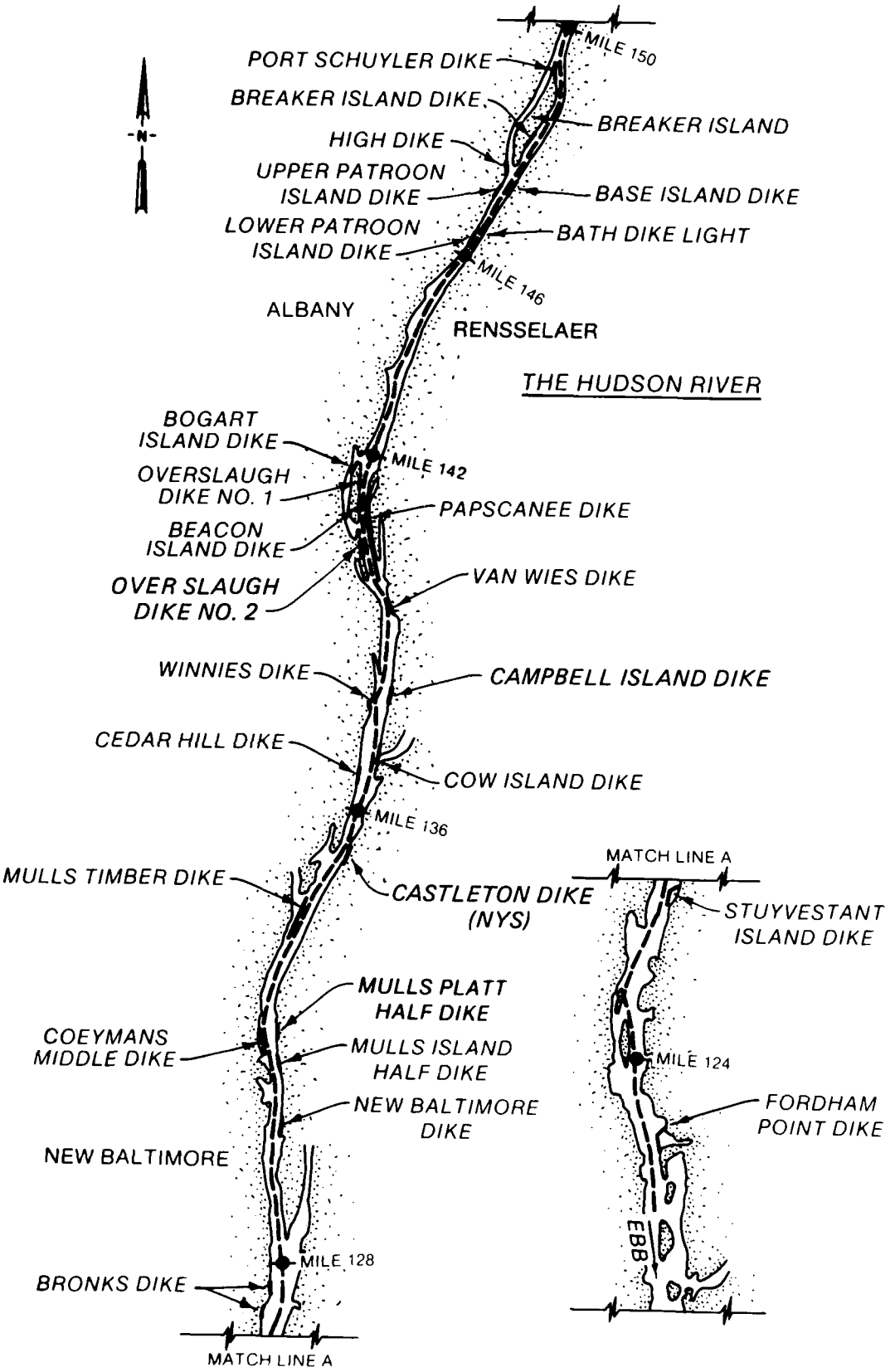

Figure 22. Training structures in the Hudson River estuary

of about 155 miles. The mean range of tide at Stuyvestant is about 4.2 ft.

(NOAA Nautical Chart No. 13448)

a. Site 2c.3, dike (longitudinal dike). Located on Fordham Point, on eastern bank, mile 122.

b. Site 2c.4, dike (longitudinal dike). Located on Stuyvestant Island, on eastern side, mile 127.

c. Site 2c.5, dike (longitudinal dike). Located on the western bank near Bronks, mile 128.

d. Site 2c.6, dike (longitudinal dike). Located at New Baltimore, on the eastern bank, mile 131.

e. Site 2c.7, dike (longitudinal dike). Located at mile 132 is the Mulls Island Half Dike, on the eastern bank.

f. Site 2c.8, dike (longitudinal dike). Mulls Platt Half Dike is located near the Mulls Island Half Dike, both being on Lower Schodak Island.

g. Site 2c.9, dike (longitudinal dike). Coeymans Middle Dike is located on the western side of the channel near Coeyman, mile 132.

h. Site 2c.10, dike (longitudinal dike). Mulls Timber Dike is located on the western side of the channel, mile 134, south of the New York State Thruway bridge.

i. Site 2c.11, dike (longitudinal dike). A New York State-maintained dike (Castleton Dike) is located on the eastern bank near mile 136.

j. Site 2c.12, dike (longitudinal dike). Cedar Hill Dike is located on the western bank just north of mile 136.

k. Site 2c.13, dike (longitudinal dike). Cow Island Dike is located on the eastern bank opposite Cedar Hill.

l. Site 2c.14, dike (longitudinal dike). Winnies Dike is located on the western bank near Bear Island, mile 138.

m. Site 2c.15, dike (longitudinal dike). Campbell Island Dike is located on the eastern bank opposite Winnies Dike.

n. Site 2c.16, dike (longitudinal dike). Van Wies Dike is located on Papscanee Island, which is east of the navigation channel, mile 139.

o. Site 2c.17, dike (longitudinal dike). Overslaugh Dike No. 2 is located on the western side of the navigation channel, mile 140.

p. Site 2c.18, dike (longitudinal dike). Beacon Island Dike is located on the western side of the navigation channel, mile 141.

q. Site 2c.19, dike (longitudinal dike). Overslaugh Dike No. 1 is adjacent to the Beacon Island Dike.

r. Site 2c.20, dike (longitudinal dike). Papscanee Dike is located opposite the previous two dikes on the eastern bank on Papscanee Island.

s. Site 2c.21, dike (longitudinal dike). Bogart Island Dike is located on Westerlo Island on the western side of the navigation channel at mile 142.

t. Site 2c.22, dike (longitudinal dike). Lower Patroon Island Dike is located on the western bank at mile 146, and is opposite the Bath Dike light (east of navigation channel).

u. Site 2c.23, dike (longitudinal dike). Upper Patroon Island Dike is north of the lower dike.

v. Site 2c.24, dike (longitudinal dike). Base Island Dike is located on the eastern bank, mile 147, and is several thousand feet long.

w. Site 2c.25, dike (longitudinal dike). High Dike is located on the western bank near the bifurcation below Breaker Island.

x. Site 2c.26, dike (longitudinal dike). Breaker Island Dike is located on Breaker Island, west of the navigation channel below the Troy-Menands Bridge.

y. Site 2c.27, dike (longitudinal dike). The Port Schuyler Dike is located on the north end of Breaker Island, west of the navigation channel, mile 149.

New York and New Jersey channels

29. Site 2d, US Dike (longitudinal dike). The dike (labeled "US DIKE") is located on the north side of the navigation channel near Shooter Island at the mouth of Newark Bay (Figure 23). The dike, which is about 4,000 ft long, protects the channel near the junction of the channel with Newark Bay. The

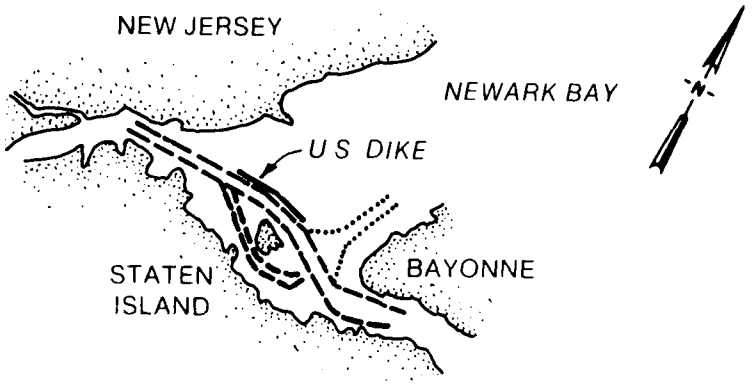

Figure 23. Shooter Island Dike

project channel is 35 ft deep and varies from 500 to 600 ft wide. The mean range of tide is about 4.9 ft.

(NOAA Nautical Chart No. 12327)

Raritan River, New Jersey

30. Site 2e, US Dike (longitudinal dike). The dike (labeled "US DIKE") is located on the north end of an island adjacent to the north navigation channel (Figure 24). The project channel is 25 ft deep and 300 ft wide near mile 5. The mean range of tide is about 5 ft.

(NOAA Nautical Chart No. 12332)

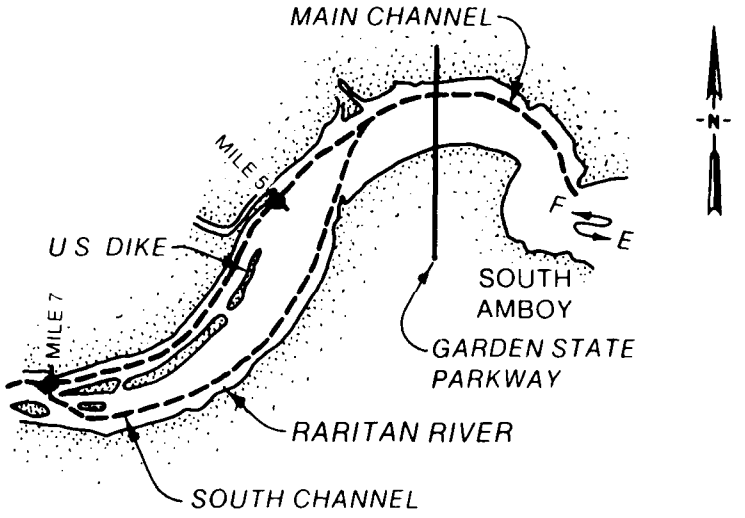

Figure 24. Raritan River Dike

Cheesequake Creek, New Jersey

31. Site 2f, jetties and dike (jetties and longitudinal dike). The structures are located near Morgan, on Raritan Bay (Figure 25). Two parallel stone jetties about 700 ft long and 200 ft apart are located along the entrance channel. The project channel in this area is 5 ft deep and 100 ft wide. A sheet-pile dike was constructed inside the entrance to close the old channel. The mean range of tide is 4.9 ft.

(NOAA Nautical Chart No. 12331)

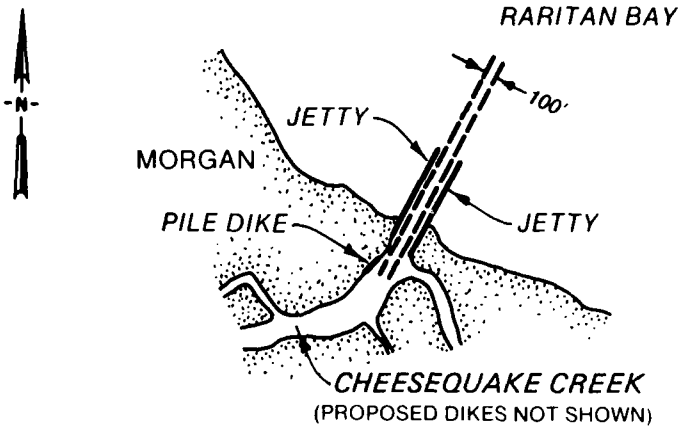

Figure 25. Training structures in Cheesequake Creek

Shoal Harbor and Compton Creek, New Jersey

32. Site 2g, dike (longitudinal dike). The dike is located at the eastern side of the entrance channel at Fishers Point (Figure 26). Although not labeled, it appears to be a closure type structure to prevent shoaling and protect the entrance from wind waves. The project channel is 12 ft deep and 75 ft wide. The mean range of tide is 4.7 ft.

(NOAA Nautical Chart No. 12324)

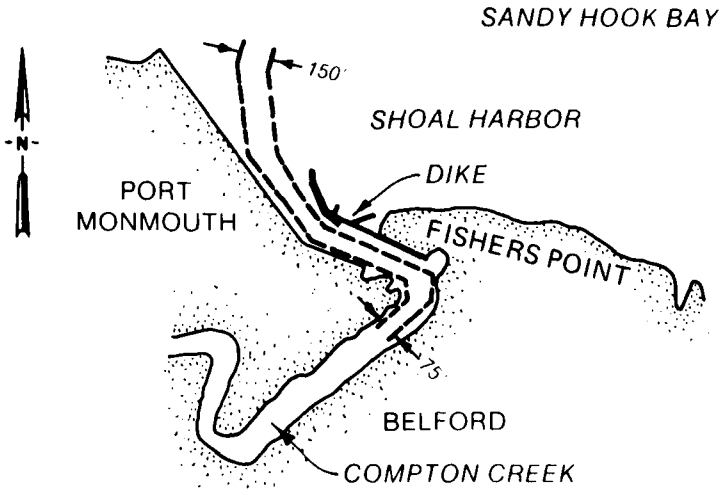

Figure 26. Dike at Shoal Harbor

Sandy Hook Bay, New Jersey

33. Site 2h, jetty. A single timber jetty was constructed at Leonardo, New Jersey, to protect the small boat harbor entrance channel (Figure 27). The jetty, which is about 220 ft long, projects north into Sandy Hook Bay and protects the project entrance, which is 8 ft deep and 150 ft wide. The mean range of tide is 4.7 ft.

(NOAA Nautical Chart No. 12330)

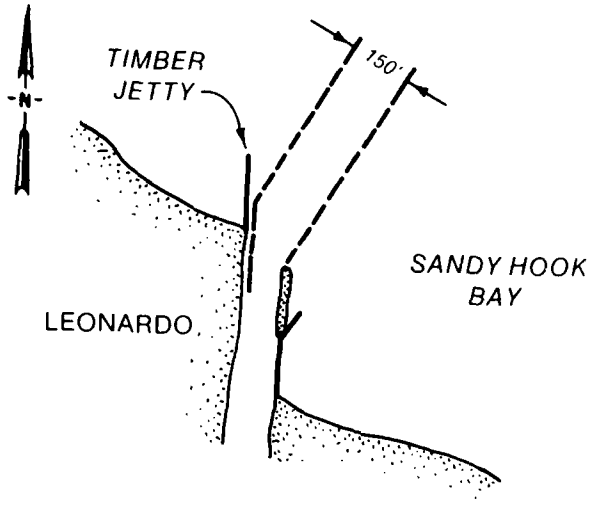

Figure 27. Harbor entrance jetty in Sandy Hook Bay

Shrewsbury River, New Jersey

34. Site 2i, dike (longitudinal dike). The dike is located at the confluence of the north and south branches of the Shrewsbury River (Figure 28).

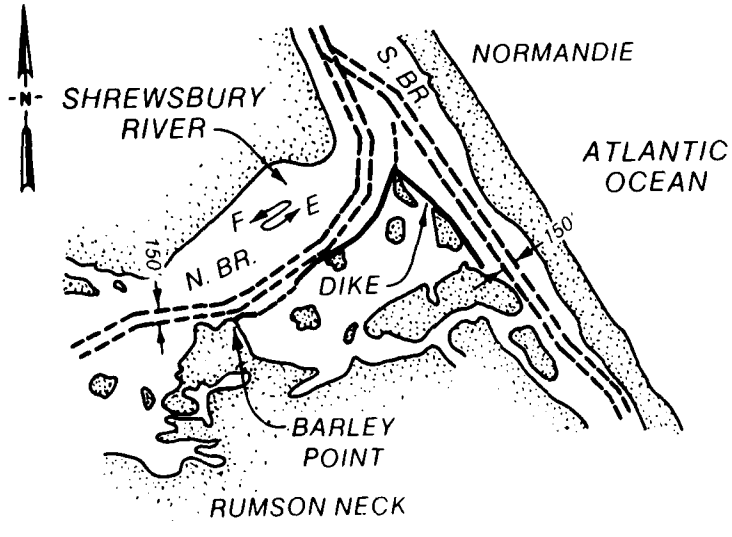

Figure 28. Longitudinal dike in the Shrewsbury River

The dike, which is almost 4,000 ft long, begins at Barley Point and extends easterly and then northerly into the bifurcation of the two channels at Normandie. At this location, the north branch project channel is 6 ft deep and 150 feet wide, and the south branch project channel is 9 ft deep and 150 ft wide. The mean range of tide is 2.8 ft.

(NOAA Nautical Chart No. 12324)

35. Site 2j has been disqualified from the inventory.

North Atlantic Division
Philadelphia District

36. About 40 training structures are within the jurisdiction of the Philadelphia District (US Army Engineer District, Philadelphia, 1979). The structures include dikes and jetties, and are located as indicated in Figure 29.

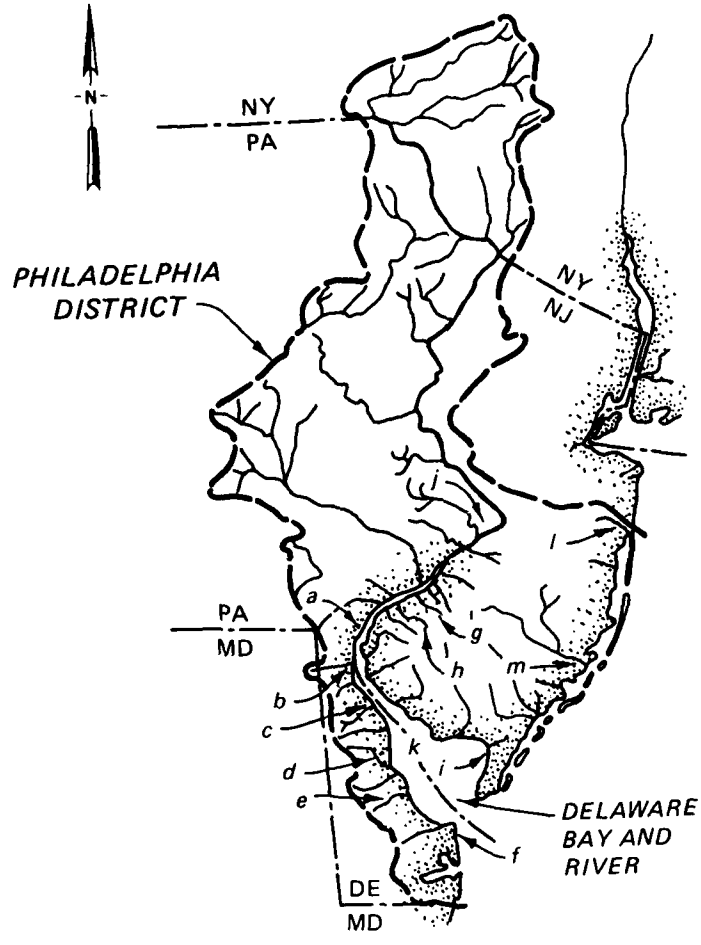

Figure 29. Location Plan 3,
Philadelphia District

Wilmington Harbor, Delaware

37. Site 3a, jetties. Two jetties extend into the Delaware River from the entrance of the Christina River (Figure 30). The south jetty, which is about 1,800 ft long, approaches the Delaware navigation channel, and the north jetty, which is about 500 ft long, is set back from the Delaware River. A third jetty maintains the channel near the entrance of the Brandywine River.

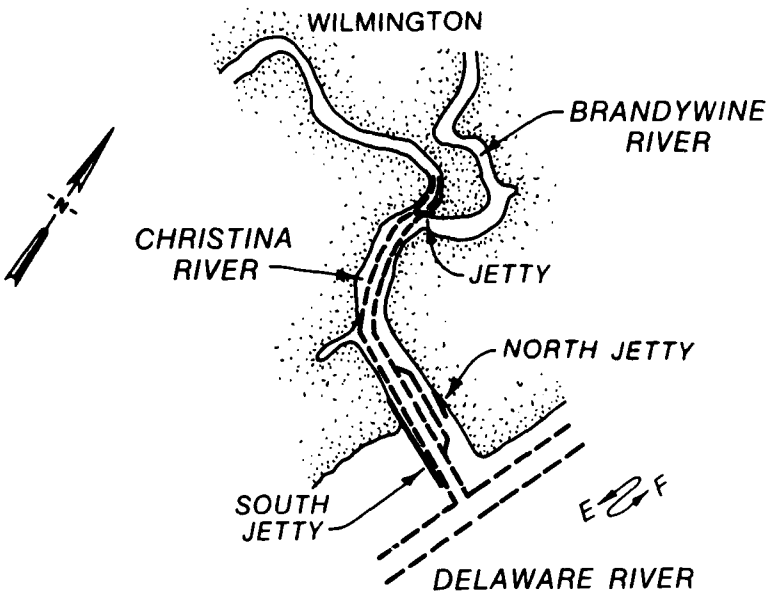

Figure 30. Jetties at Wilmington Harbor

The Christina River channel project dimensions are 35 ft deep and 400 ft wide at the entrance, and 21 ft deep and 250 ft wide at the confluence with the Brandywine. The mean range of tide at the mouth is 5.6 ft.

(NOAA Nautical Chart No. 12311)

Inland Waterway, Delaware River to
Chesapeake Bay, C & D Canal, Delaware

38. Site 3b, jetties. Two jetties were constructed at the entrance of the C & D Canal into the Delaware River and later authorized for extension (Figure 31). The jetties are approximately 2,000 ft long, and the canal dimensions are 35 ft deep and 450 ft wide. The mean range of tide is estimated at 2.5 ft near Reedy Point.

(NOAA Nautical Chart No. 12277)

Smyrna River, Delaware

39. Site 3c, jetties. Two parallel stone-filled pile and timber jetties were constructed in 1939 at the entrance to the Delaware Bay (Figure 32). The jetties, the longest of which is about 2,800 ft long, protect the

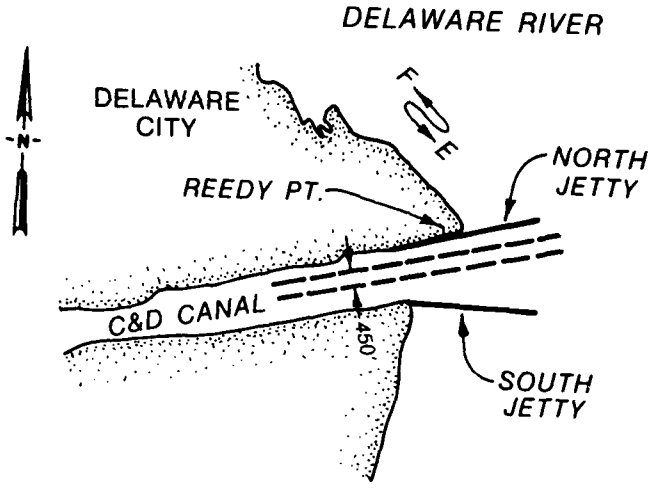

Figure 31. C & D Canal entrance jetties

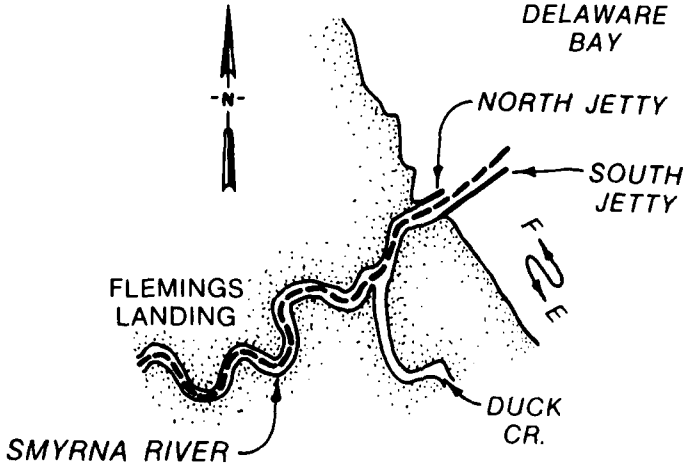

Figure 32. Entrance jetties for the Smyrna River

7-ft-deep by 100-ft-wide navigation channel. The range of tide at the mouth is 6.0 ft.

(NOAA Nautical Chart No. 12311)

St. Jones River, Delaware

40. Site 3d has been disqualified from the inventory.

Mispillion River, Delaware

41. Site 3e, jetties. Two stone-filled pile and timber jetties were constructed in 1939 at the mouth of the river (Figure 33). The 5,000-ft-long jetties protect the 9-ft-deep by 80-ft-wide entrance channel. The mean range of tide at the mouth is 4.4 ft.

(NOAA Nautical Chart No. 12304)

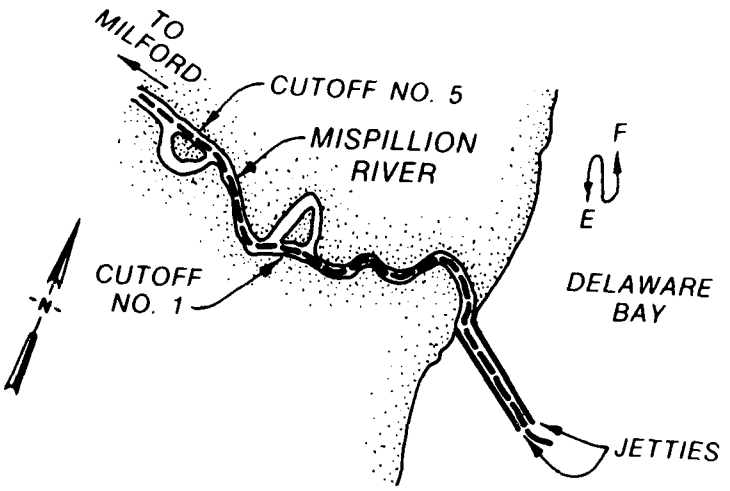

Figure 33. Mispillion River entrance jetties

Inland Waterway, Rehoboth Bay to Delaware Bay, Delaware

42. Site 3f, jetties. Two parallel jetties were constructed in 1938 at the Delaware Bay entrance (Figure 34). The jetties at the Rehoboth Bay entrance were constructed in 1903 under a previous project. The project dimensions at the Delaware Bay entrance are 10 ft deep and 200 ft wide. The

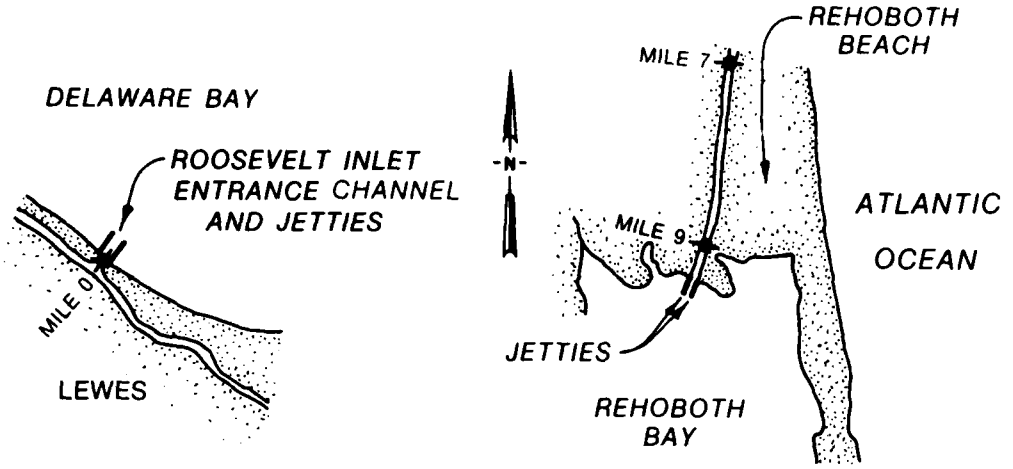

Figure 34. Inland Waterway entrance jetties

mean range of tide is 4.2 ft at the entrance and 0.6 ft at the Rehoboth Bay entrance.

(NOAA Nautical Chart No. 12216)

Mantua Creek, New Jersey

43. Site 3g, jetties. Two parallel jetties were constructed in 1940 at the entrance to the Delaware River (Figure 35). The jetties were rehabilitated under contract in 1963. The project dimensions at the entrance are 20 ft in depth and 110 ft in width. The mean range of tide is 5.9 ft.

(NOAA Nautical Chart No. 12312)

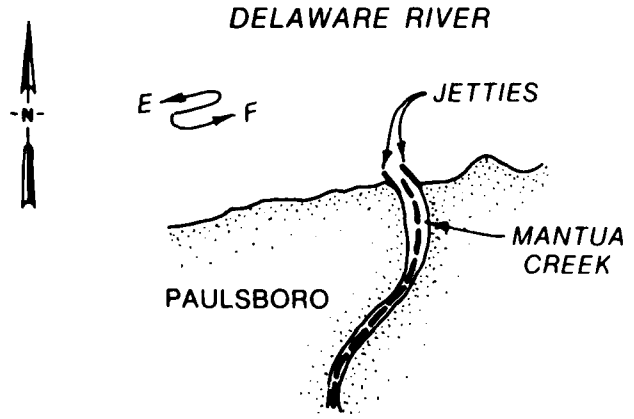

Figure 35. Mantua Creek entrance jetties

Raccoon Creek, New Jersey

44. Site 3h, jetty. A jetty was constructed in 1922 to protect the western side of the entrance channel (Figure 36). The project dimensions at the entrance are 7 ft in depth and 75 ft in width. The mean range of tide is 5.8 ft.

(NOAA Nautical Chart No. 12312)

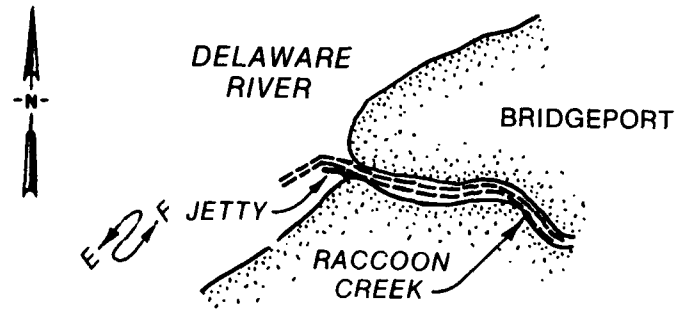

Figure 36. Raccoon Creek entrance jetty

Goshen Creek, New Jersey

45. Site 3i, jetties. Two jetties were constructed in 1900 to protect the entrance channel to Delaware Bay (Figure 37). No maintenance has been accomplished and the project is considered inactive. The project dimensions at the jetties were 3 ft deep and 50 ft wide. The mean range of tide is 5.6 ft.

(NOAA Nautical Chart No. 12214)

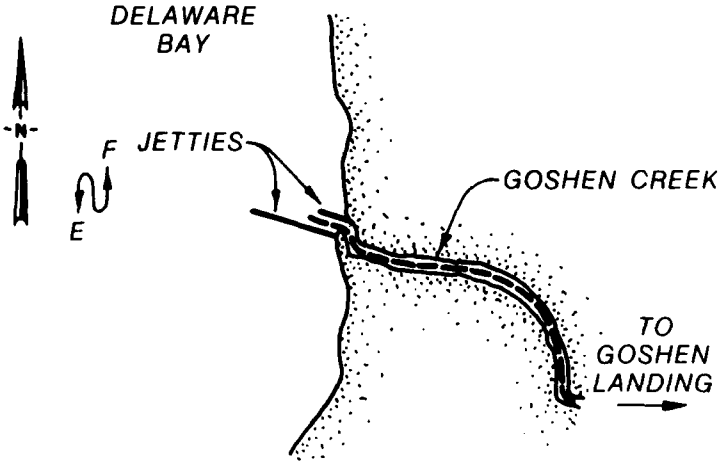

Figure 37. Goshen Creek entrance jetty

Neshaminy State Park Harbor, Pennsylvania

46. Site 3j, jetty. A stone jetty, 230 ft long, was completed in 1938 at the harbor entrance to the Delaware River under the Small Navigation Program, Section 107, River and Harbor Act of 1960 (Figure 38). The entrance channel is 8 ft deep and 60 ft wide. The mean range of tide is not listed.

(NOAA Nautical Chart No. 12314)

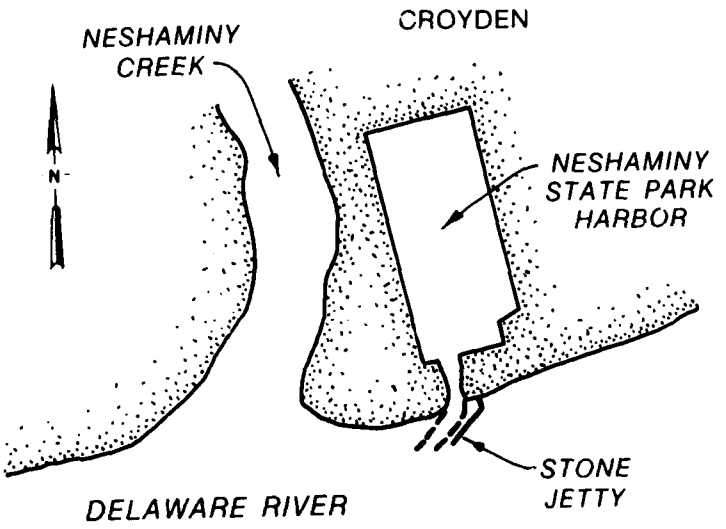

Figure 38. Neshaminy Harbor entrance jetty

Delaware River, Philadelphia, Pennsylvania, to the sea

47. Several structures were constructed in this estuary, including the following, shown in Figure 39:

a. Site 3k.1, Fisher Point Dike (longitudinal dike). The dike is located near Allegheny Avenue, on the Camden, New Jersey (east), side of the channel. The navigation channel at this location is 40 ft deep and 400 to 500 ft wide. The range of tide is 6.0 ft.

b. Site 3k.2, Howell Cove Dike (longitudinal dike). The dike is located near the mouth of Big Timber Creek on the New Jersey (east) side of the channel. In this location, the navigation project is 37 ft deep and 500 to 600 ft wide.

c. Site 3k.3, Mifflin Bar Dike (longitudinal dike). The dike is located near the Philadelphia International Airport on the Pennsylvania (west) side of the channel. In this location, the navigation channel is 40 ft deep and 800 ft wide.

d. Site 3k.4, Chester Island Dike (lateral dike). The dike is

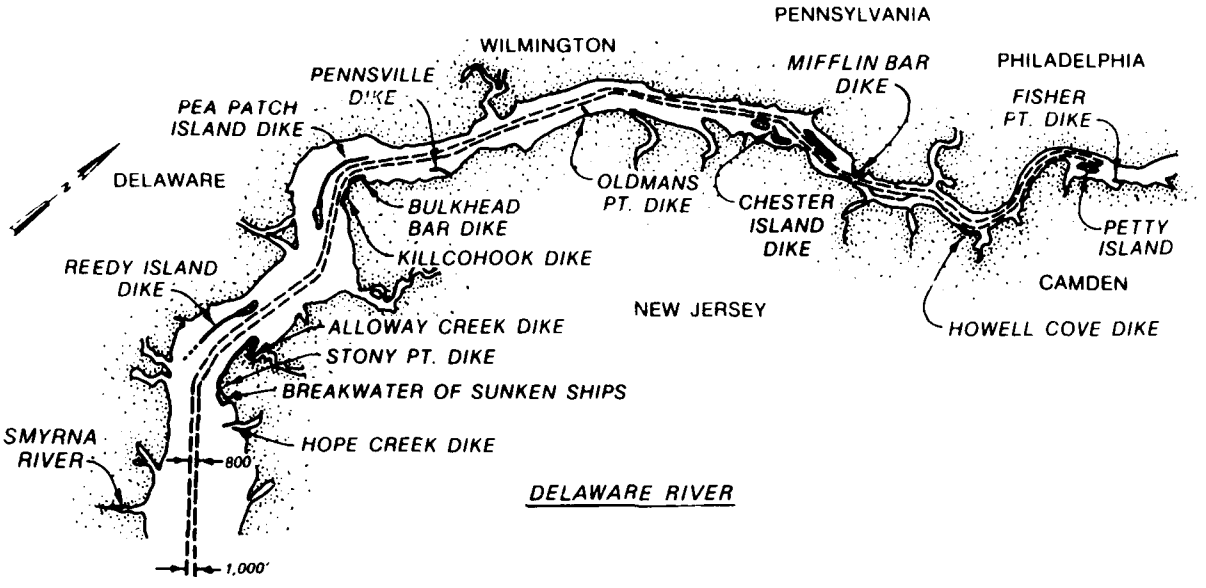

Figure 39. Training structures in the Delaware River estuary

located on the east side of the channel near Chester, Pennsylvania. In this area the navigation channel is 40 ft deep and 800 ft wide.

e. Site 3k.5, Oldmans Point Dike (lateral dike). The dike is located on the east side of the channel north of Pennsgrove, New Jersey. The navigation channel in this area is 40 ft deep and 800 ft wide.

f. Site 3k.6, Pennsville Dike (longitudinal dike). The dike is located south of the Twin Delaware Memorial Bridges on the east bank. The structure projects westerly about 1,400 ft, and then 1,400 ft parallel with the navigation channel.

g. Site 3k.7, Pea Patch Island Dike (longitudinal dike). The dike is located south of New Castle, Delaware, in the New Castle range of the navigation channel. The structure begins at Pea Patch Island, which is west of the channel, and arcs north, then east for about 3 miles.

h. Site 3k.8, Bulkhead Bar Dike (longitudinal dike). The dike is located on the New Jersey (east) side of the channel opposite the northern end of the Pea Patch Island Dike. The navigation channel in this area is 40 ft deep and 800 ft wide.

i. Site 3k.9, Killcohook Dike (longitudinal dike). The dike is located on the New Jersey (east) side of the navigation channel opposite the southern end of the Pea Patch Island Dike. The channel in this area is 40 ft deep and 800 ft wide.

j. Site 3k.10, Reedy Island Dike (longitudinal dike). The structure is located west of the channel and south of Port Penn, Delaware. The structure begins at Reedy Island, and extends south for almost 3 miles.

k. Site 3k.11, Alloway Creek Dike (lateral dike). The dike is located at the northern end of Artificial Island on the New Jersey (east) side at the mouth of Alloway Creek. The navigation channel in this area is 40 ft deep and 800 ft wide.

l. Site 3k.12, Stony Point Dike (longitudinal dike). The dike is located just south of Alloway Creek on the east bank. The structure parallels the bank; however, it is tied to the bank by a breakwater of sunken ships.

m. Site 3k.13, Hope Creek Dike (lateral dike). The dike is located immediately below Stony Point. The dike is perpendicular to the channel and extends about 2,000 ft west from the bank. The range of tide is about 5.8 ft.

(NOAA Nautical Chart Nos. 12311, 12312, 12313)

Double Creek, New Jersey

48. Site 31, jetty. The project includes a pile and timber jetty at the mouth of Double Creek in Barnegat Bay (Figure 40). The jetty is 550 ft long and located on the north side of the navigation channel, which is 5 ft deep and 40 ft wide. The project, which was completed in 1912 and maintained by local interests, has a mean range of tide of 0.5 ft at the mouth.

(NOAA Nautical Chart No. 12324)

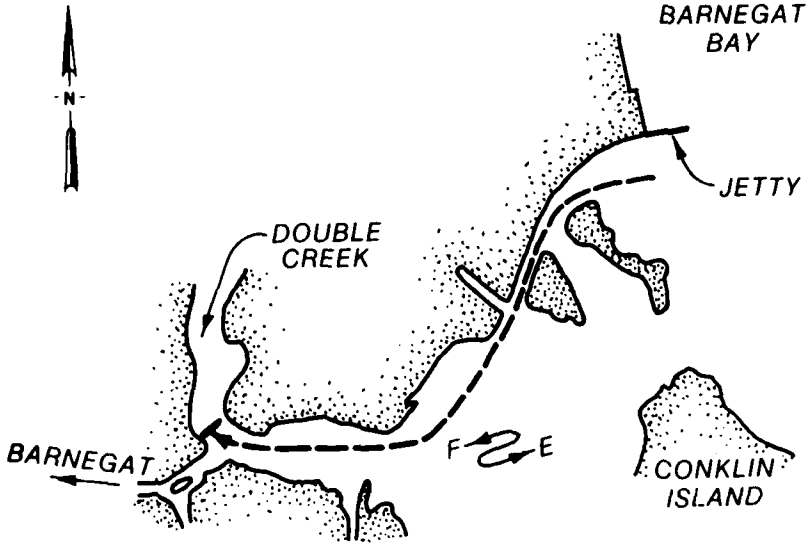

Figure 40. Double Creek entrance jetty

New Jersey Intracoastal
Waterway, Cape May Canal

49. Site 3m, jetties. Two parallel stone jetties were constructed in 1942 at the Delaware Bay entrance of the canal (Figure 41). The canal connects Cape May Harbor and the Intracoastal Waterway (ICWW) to the southern areas of Delaware Bay. The mean range of tide at the ICWW Delaware Bay entrance is 4.7 ft.

(NOAA Nautical Chart No. 12317)

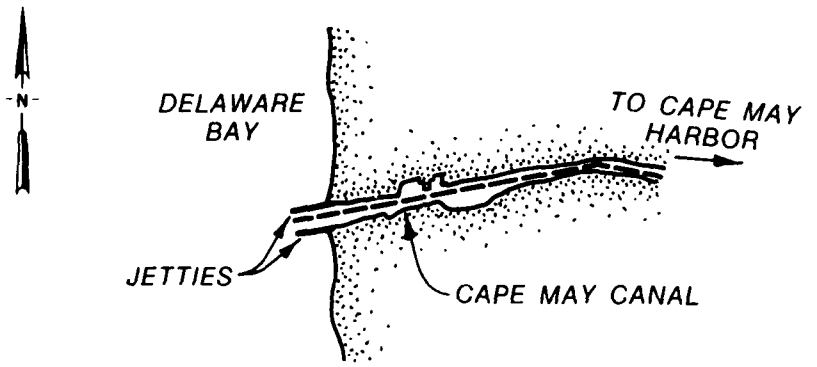

Figure 41. Cape May Canal entrance jetties

North Atlantic Division

Baltimore District

50. The Baltimore District lists about 18 training structures within the District's jurisdiction (US Army Engineer District, Baltimore, 1979). The structures include jetties and one timber bulkhead. The navigation projects are located as indicated in Figure 42.

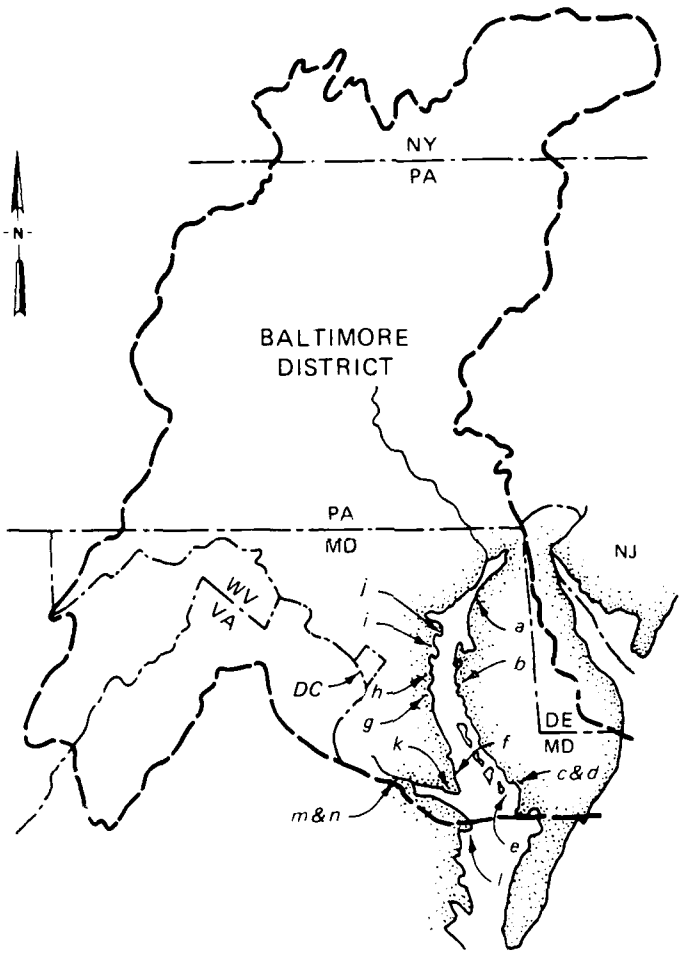

Figure 42. Location Plan 4, Baltimore District

Betterton Harbor, Maryland

51. Site 4a has been disqualified from the inventory.

Claiborne Harbor, Maryland

52. Site 4b, jetty. The project, which was completed in 1931, includes a harbor entrance channel and a jetty in Eastern Bay (Figure 43). The 150-ft-long slag jetty extends westward from a government wharf. The project channel

is 14 ft deep and 100 ft wide. The mean range of tide is 2.0 ft.

(NOAA Nautical Chart No. 12270)

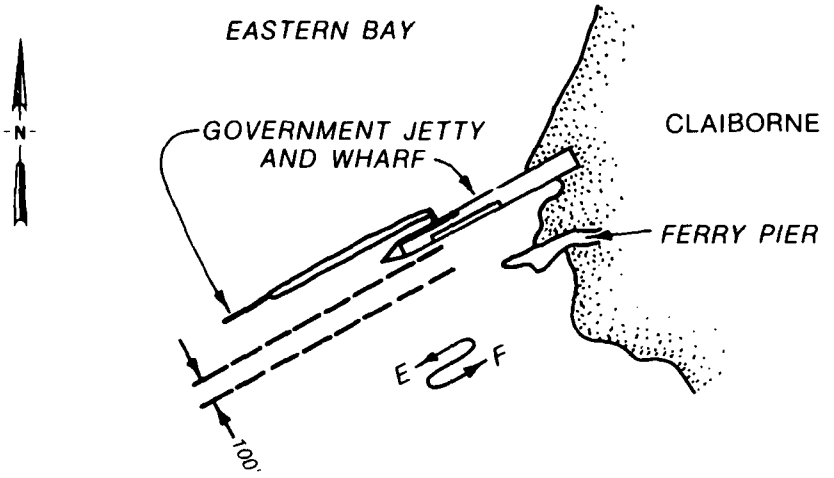

Figure 43. Harbor entrance jetty at Claiborne

Bivalve, Maryland

53. Site 4c, jetties. The project includes two parallel stone jetties (Figure 44). The jetties extend about 1,000 ft west in the Nanticoke River. The stone jetties protect the project entrance channel, which is 7 ft deep and 60 ft wide. The mean range of tide is 2.5 ft.

(NOAA Nautical Chart No. 12261)

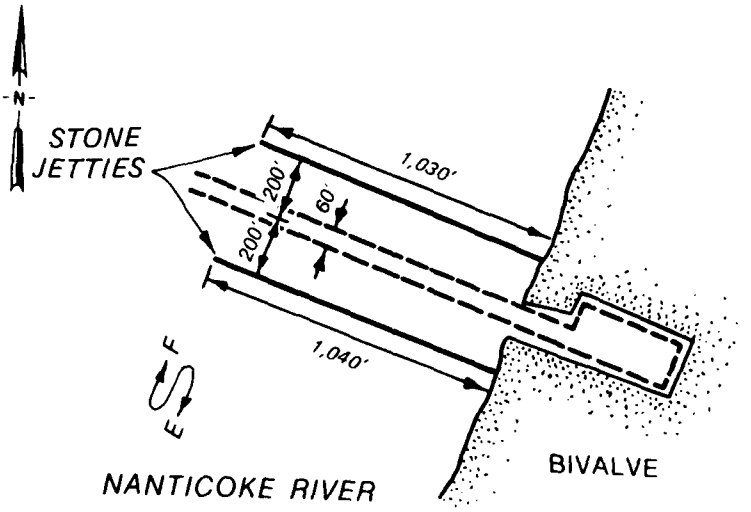

Figure 44. Harbor entrance jetties at Bivalve

Nanticoke, Maryland

54. Site 4d, jetties. The project provides for a small boat harbor at Nanticoke, with an entrance channel protected by jetties (Figure 45). The stone jetties, which are not parallel, extend westward into the Nanticoke River 800 and 700 ft, respectively, for the north and south locations. The project channel is 7 ft deep and 60 ft wide. The mean range of tide is 2.6 ft.

(NOAA Nautical Chart No. 12261)

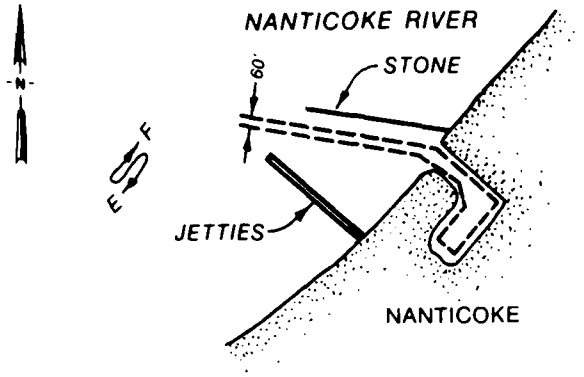

Figure 45. Harbor entrance jetties at Nanticoke

Twitch Cove and Big Thorofare River, Maryland

55. Site 4e, jetties. The project, located on Smith Island in the eastern Chesapeake Bay, includes twin jetties (Figure 46). The jetties protect the bay entrance of the channel that leads to Twitch Cove in Tangier Sound. The stone jetties were completed in 1956. The project channel at the entrance is 100 ft wide and 7 ft deep. The mean range of tide is 1.7 ft.

(NOAA Nautical Chart No. 12231)

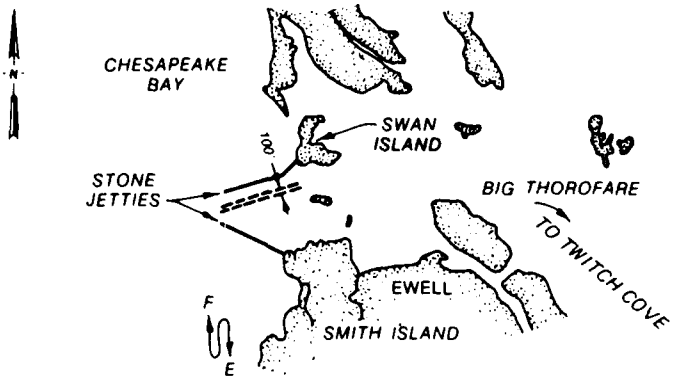

Figure 46. Entrance jetties at the Big Thorofare River

Governors Run, Maryland

56. Site 4f has been disqualified from the inventory.

Fishing Creek, Chesapeake Beach, Maryland

57. Site 4g, jetties. The project includes twin stone jetties protecting the entrance to Fishing Creek (Figure 47). The structures are each about 1,000 ft long and were completed in 1942. The jetties protect the 60-ft-wide by 7-ft-deep project entrance channel.

(NOAA Nautical Chart No. 12270)

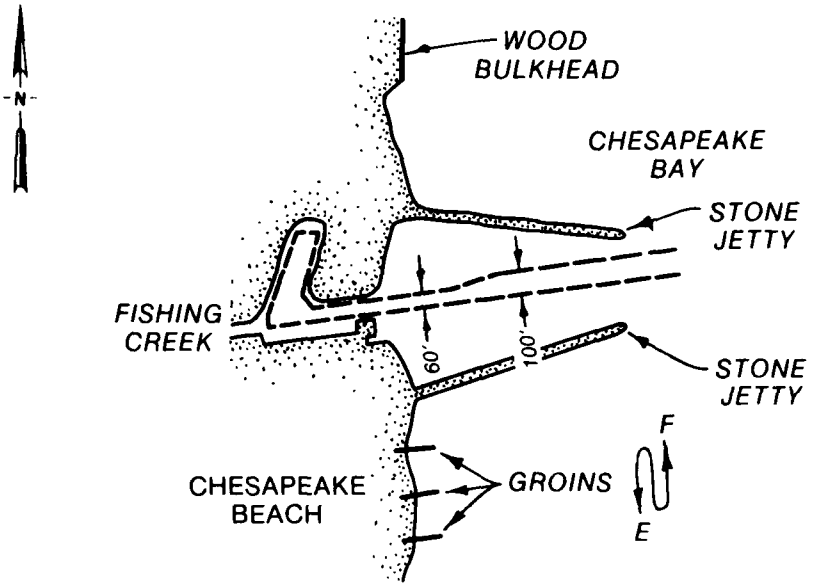

Figure 47. Entrance jetties at Fishing Creek

Broadwater Creek, Maryland

58. Site 4h has been disqualified from the inventory.

Lake Ogleton, Maryland

59. Site 4i has been disqualified from the inventory.

Back Creek, Maryland

60. Site 4j, jetty. The project, located near Eastport, provides for a navigation channel with a jetty protecting the entrance (Figure 48). The stone jetty, completed in 1939, is about 600 ft long and located on the south side of the entrance. The project channel is 100 ft wide and 8 ft deep. The mean range of tide is 0.9 ft.

(NOAA Nautical Chart No. 12270)

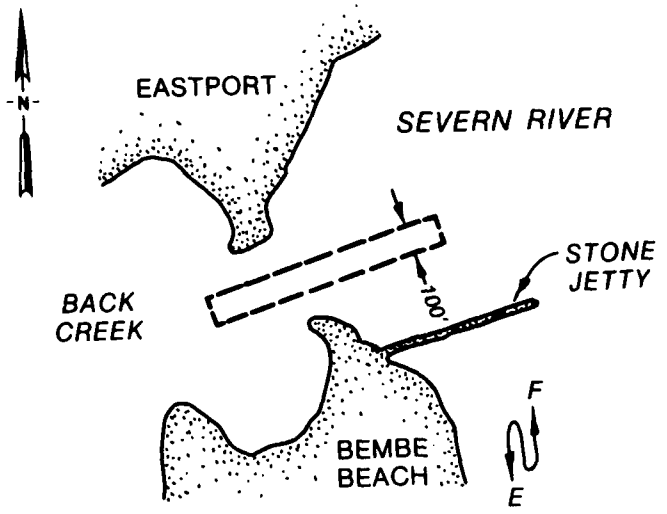

Figure 48. Jetty at Back Creek

Herring Creek, Maryland

61. Site 4k, jetties. Two stone jetties protect the project entrance to Herring Creek, near Tall Timbers, Maryland (Figure 49). The jetties, which are 770 and 650 ft long, were completed in 1961. The project navigation channel is 60 ft wide and 6 ft deep at the entrance. The range of tide (Potomac River) is 1.6 ft.

(NOAA Nautical Chart No. 12286)

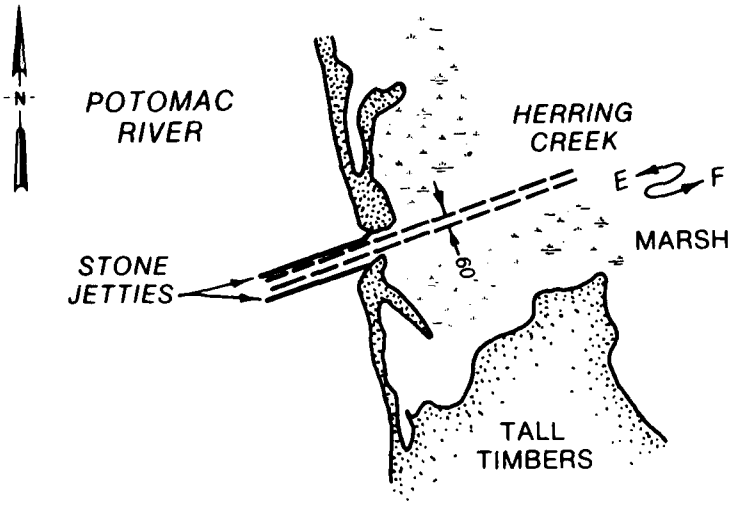

Figure 49. Jetties at Herring Creek

Little Wicomico River, Virginia

62. Site 41, jetties and bulkhead. The project is located on the southern bank of the confluence of the Potomac River and the Chesapeake Bay (Figure 50). The project entrance is protected by two stone jetties: the northern jetty, which is about 1,000 ft long, and the southern jetty, which is about 1,300 ft long. Within the entrance, 1,007 lin ft of timber bulkhead was constructed to stabilize the dredged inner channel. The project navigation channel dimensions are 150 ft wide and 8 ft deep. The range of tide is 1.2 ft.

(NOAA Nautical Chart No. 13298)

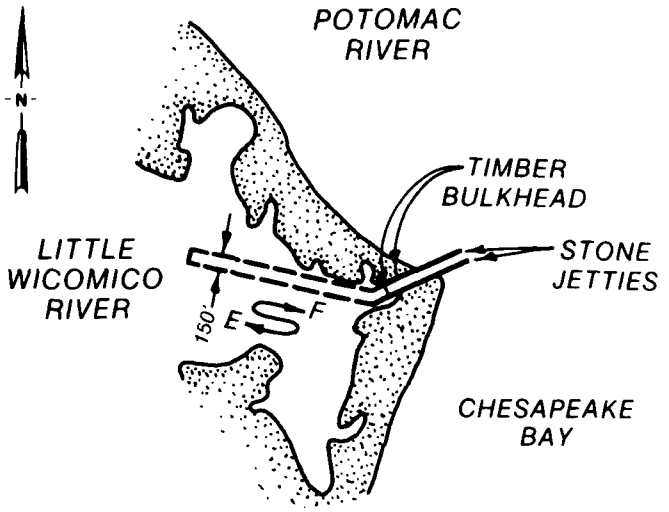

Figure 50. Jetties at the Little Wicomico River

Bonum Creek, Virginia

63. Site 4m, jetties. The navigation project is located near Tucker Hill on the Potomac River (Figure 51). The project provides for jetties to protect the entrance channel. The north jetty extends about 700 ft into the Potomac River and the south jetty extends about 300 ft. The project navigation channel is 60 ft wide and 6 ft deep. The range of tide is 1.6 ft.

(NOAA Nautical Chart No. 12286)

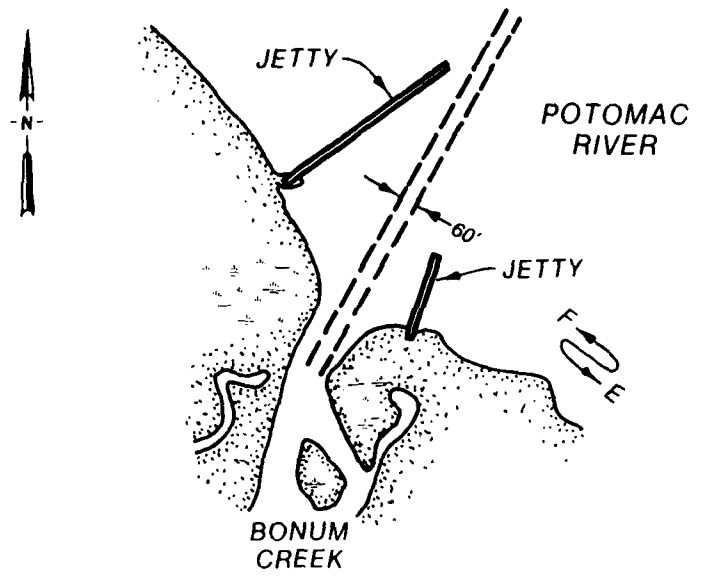

Figure 51. Jetties at Bonum Creek

Nomini Creek, Virginia

64. Site 4n, jetty. The navigation project provides for a stone jetty 2,410 ft long at the entrance of Nomini Creek to Nomini Bay (Figure 52). The project channel, which is 150 ft wide and 9 ft deep, and the jetty were completed in 1912. The range of tide is 1.8 ft.

(NOAA Nautical Chart No. 12286)

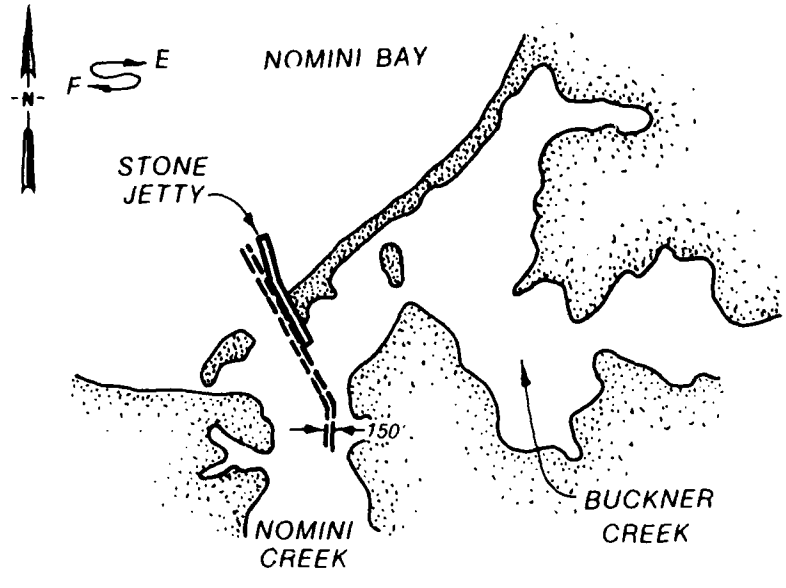

Figure 52. Jetty at Nomini Creek

North Atlantic Division

Norfolk District

65. The Norfolk District lists several training structures within the District's jurisdiction (US Army Engineer District, Norfolk, 1984). The structure types include dikes and jetties, and are located as indicated in Figure 53.

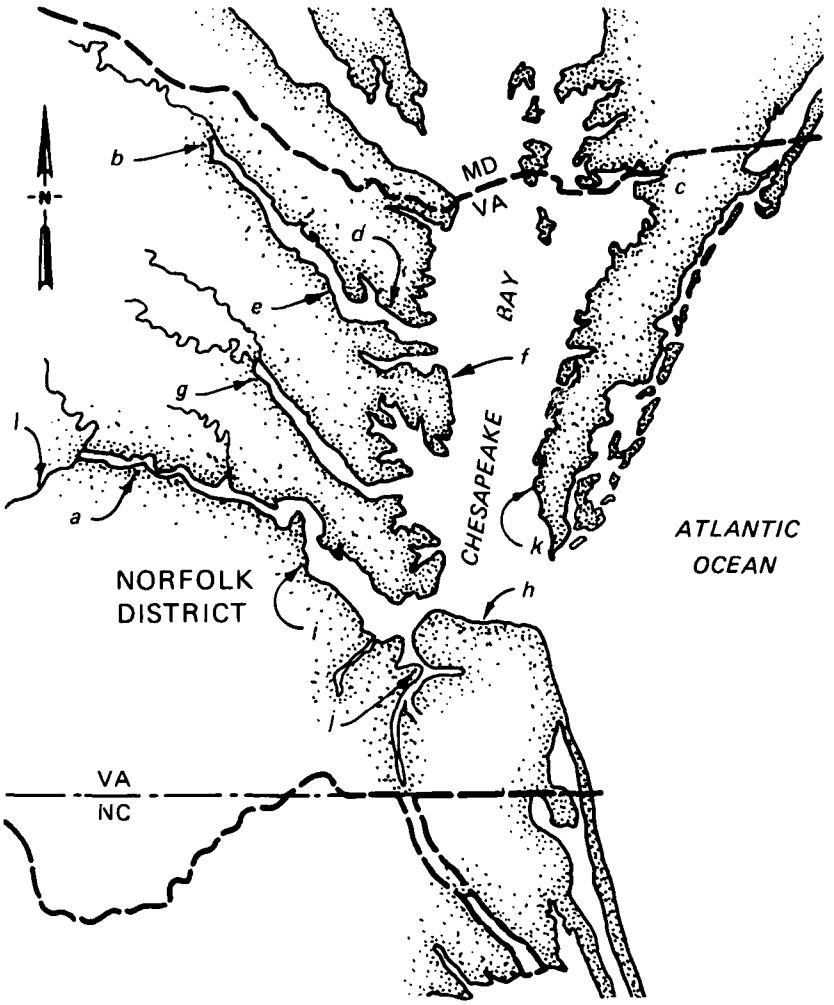

Figure 53. Location Plan 5, Norfolk District

James River, Virginia

66. Site 5a, spur and training dikes (longitudinal and lateral dikes). The navigation project provides for the construction of spur and training dikes along both banks of the James River between miles 75 and 90, south of

Richmond (Figure 54). No information is provided other than the general locations and that construction is complete (US Army Engineer District, Norfolk, 1984). The project navigation channel is 200 ft wide and 18 ft deep. The mean range of tide is about 3.2 ft.

(NOAA Nautical Chart No. 12251)

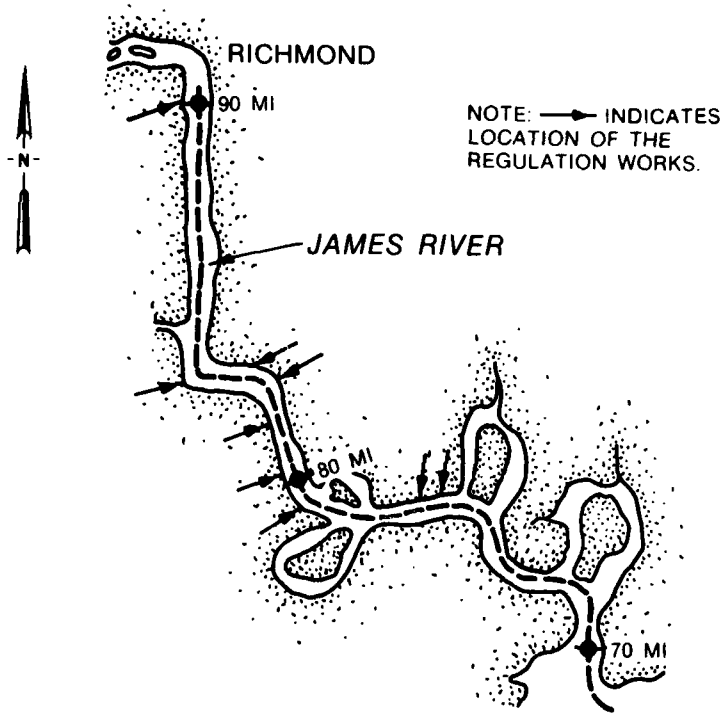

Figure 54. Location of the James River dikes

Rappahannock River, Virginia

67. Site 5b, dikes (longitudinal and lateral dikes). The navigation project provides for the construction of 20,401 lin ft of crib and pile dikes and 1,906 lin ft of riprap stone dike (Figure 55). Nine locations are noted on the project map as having contraction works but have no further identification or length. This particular reach is from Fredericksburg to mile 90 where the project navigation channel is 100 ft wide and 12 ft deep. The mean range of tide is about 2.8 ft.

(NOAA Nautical Chart No. 12237)

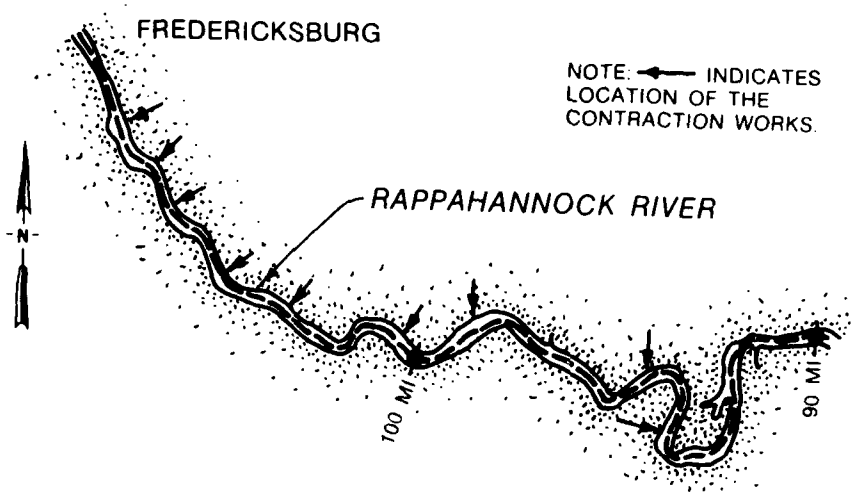

Figure 55. Location of the Rappahannock River dikes

Chincoteague Bay, Virginia

68. Site 5c has been disqualified from the inventory.

Carters Creek, Virginia

69. Site 5d, jetty. The navigation project provides for a jetty to protect the entrance channel to Carters Creek (Figure 56). The stone structure extends 742 ft to the south in the Rappahannock River. The project channel is 200 ft wide and 15 ft deep. The mean range of tide is about 1.4 ft.

(NOAA Nautical Chart No. 12237)

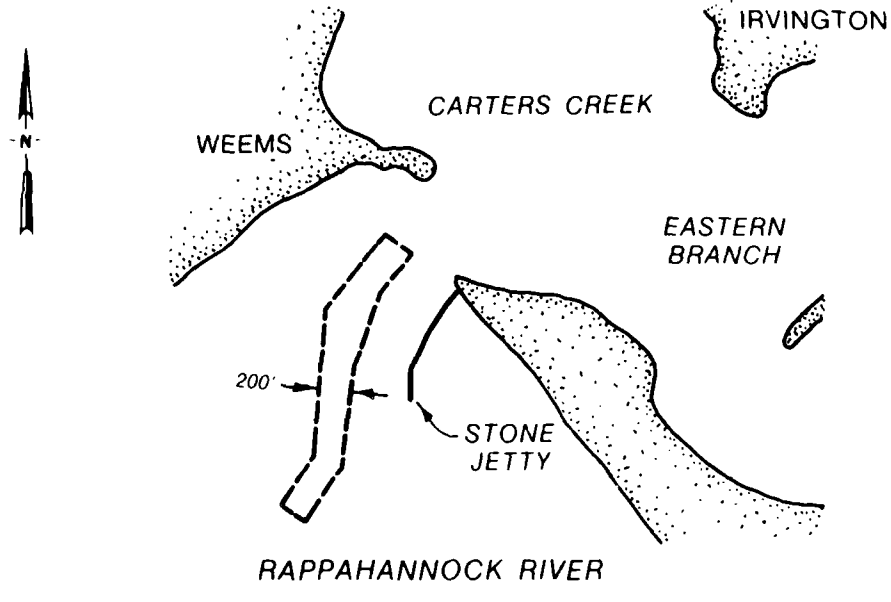

Figure 56. Carters Creek entrance jetty

Urbanna Creek, Virginia

70. Site 5e, jetties. The navigation project includes two jetties to protect the entrance channel to the Rappahannock River (Figure 57). The north jetty was constructed of stone and is 1,895 ft long, and the south jetty was constructed of timber and is 717 ft long. The project channel dimensions are 150 ft wide and 10 ft deep. The mean range of tide is about 1.6 ft.

(NOAA Nautical Chart No. 12237)

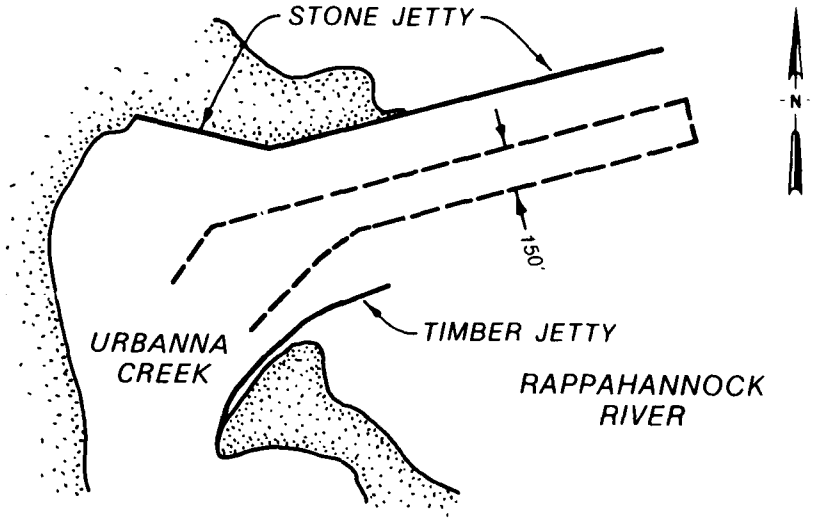

Figure 57. Urbanna Creek entrance jetties

Milford Haven, Virginia

71. Site 5f, jetty. The navigation project, located at the south end of Hills Bay, includes a jetty on the north side of the entrance (Figure 58). The stone jetty extends 1,183 ft from Narrows Point into Hills Bay. The project channel dimensions are 200 ft wide and 10 ft deep. The mean range of tide is about 1.3 ft.

(NOAA Nautical Chart No. 12238)

York River, Virginia

72. Site 5g, dike (longitudinal dike). A dike was constructed to control shoaling at the West Point Bar, river mile 32 (Figure 59). The dike, which is about 1,000 ft long, is located on the west side of the navigation

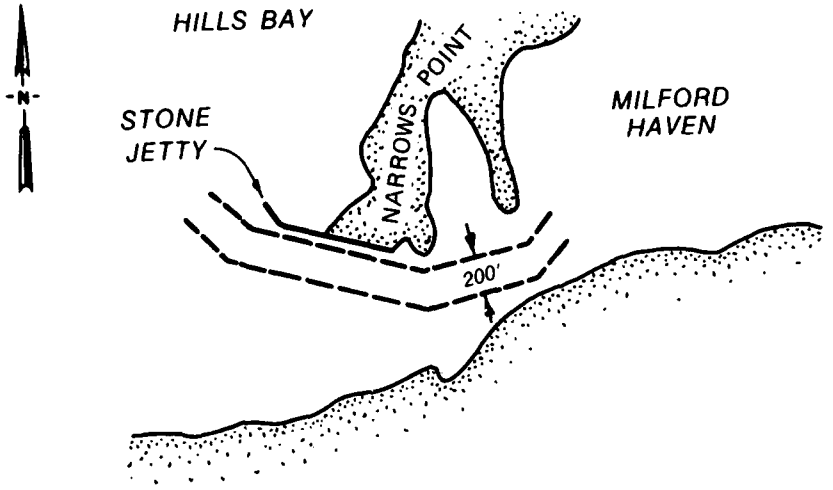

Figure 58. Jetty at Milford Haven

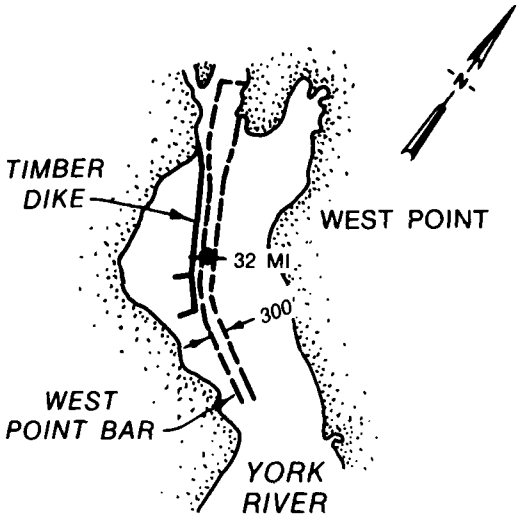

Figure 59. West Point Bar dike

channel. The project channel is 300 ft wide and 22 ft deep. The mean range of tide is about 3.0 ft.

(NOAA Nautical Chart No. 12243)

Little River (Creek), Virginia

73. Site 5h, jetties. Two stone jetties are indicated on the project map at the entrance to Little River (Figure 60). The west jetty is about 600 ft long and the east jetty about 1,000 ft long. The project entrance

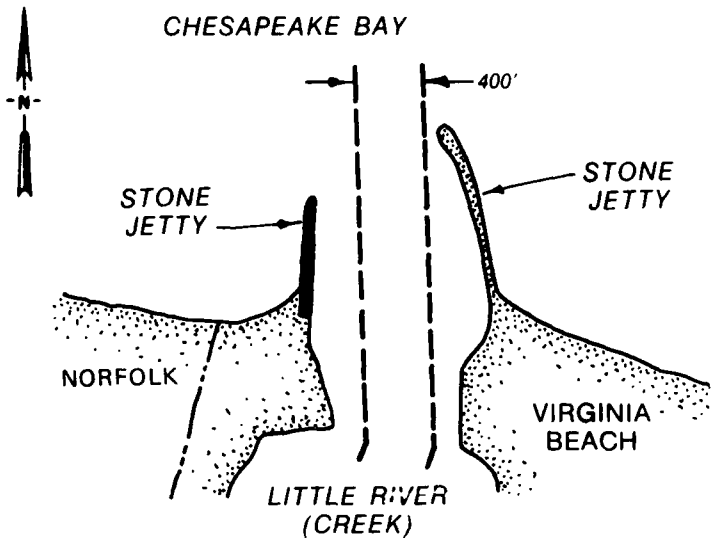

Figure 60. Jetties at the Little River (Creek) entrance

channel is 400 ft wide and 20 ft deep. The mean range of tide is about 2.6 ft.

(NOAA Nautical Chart No. 12222)

Tylers Beach, Virginia

74. Site 5i, jetties. The navigation project provides for two jetties to protect the entrance channel to the harbor of refuge (Figure 61). Located in Burwells Bay, the two stone revetment/jetty structures, each 370 ft long,

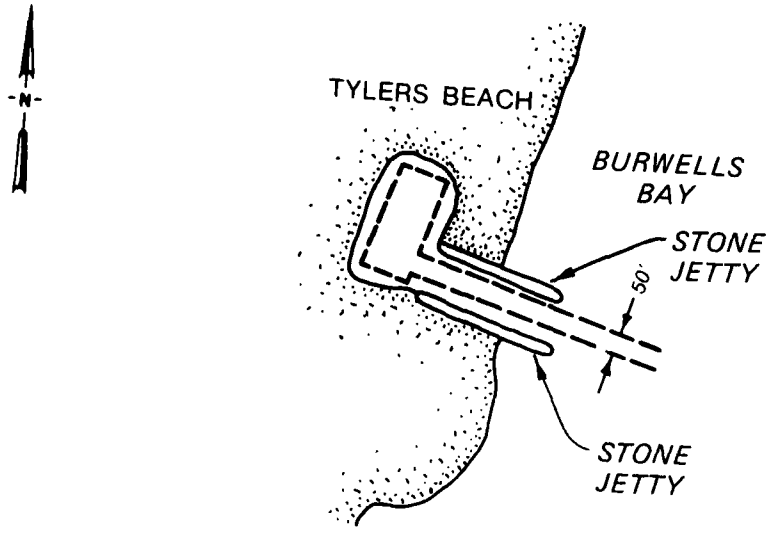

Figure 61. Tylers Beach entrance jetties

were constructed in 1982. The project channel is 50 ft wide and 6 ft deep. The mean range of tide is about 2.4 ft.

(NOAA Nautical Chart No. 12248)

Norfolk Harbor, Virginia

75. Site 5j has been disqualified from the inventory.

Cape Charles City Harbor, Virginia

76. Site 5k, jetty. The navigation project provides for a jetty to protect the harbor of refuge entrance (Figure 62). The jetty, which is about 1,400 ft long, is located on the north side of the harbor entrance from the Chesapeake Bay. The project channel is 500 ft wide and 18 ft deep. The mean range of tide is about 2.4 ft.

(NOAA Nautical Chart No. 12224)

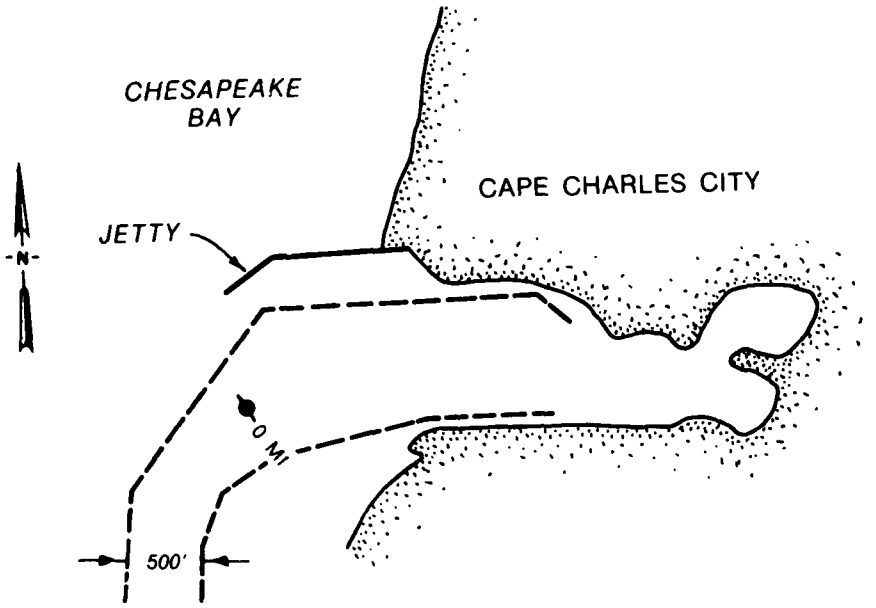

Figure 62. Cape Charles City Harbor entrance jetty

Appomattox River, Virginia

77. Site 51, levee (barrier dike). The navigation project provides for a levee approximately 1.7 miles long on the ground between the navigation channel and a diversion channel (Figure 63). The purpose of the levee is to divert silt-laden floodwaters away from the navigation channel and into the

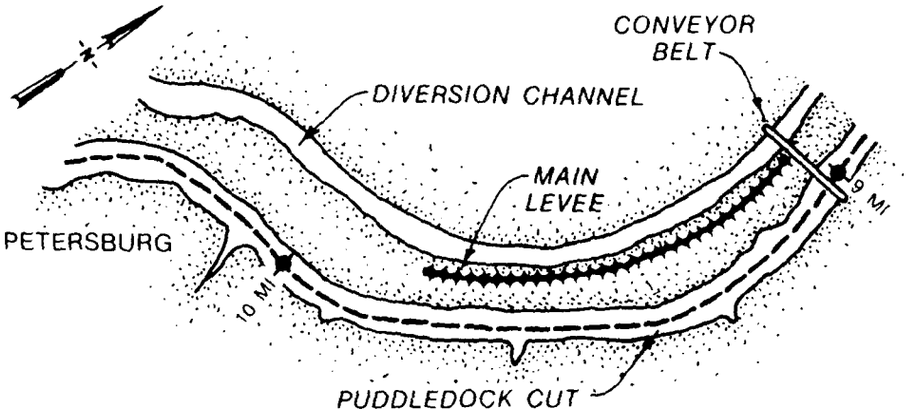

Figure 63. Diversion levee on the Appomattox River, Virginia

diversion channel. The levee is about 1 mile east of the dam at Petersburg, which is the upstream limit of the Federal project. The project channel is 80 ft wide and 10 ft deep. The mean range of tide is about 2.9 ft at Petersburg.

(NOAA Nautical Chart No. 12251)

South Atlantic Division
Wilmington District

78. The Wilmington District lists four training structures, including training walls and jetties, within the District's jurisdiction (US Army Engineer District, Wilmington, 1981). The projects are located as indicated in Figure 64.

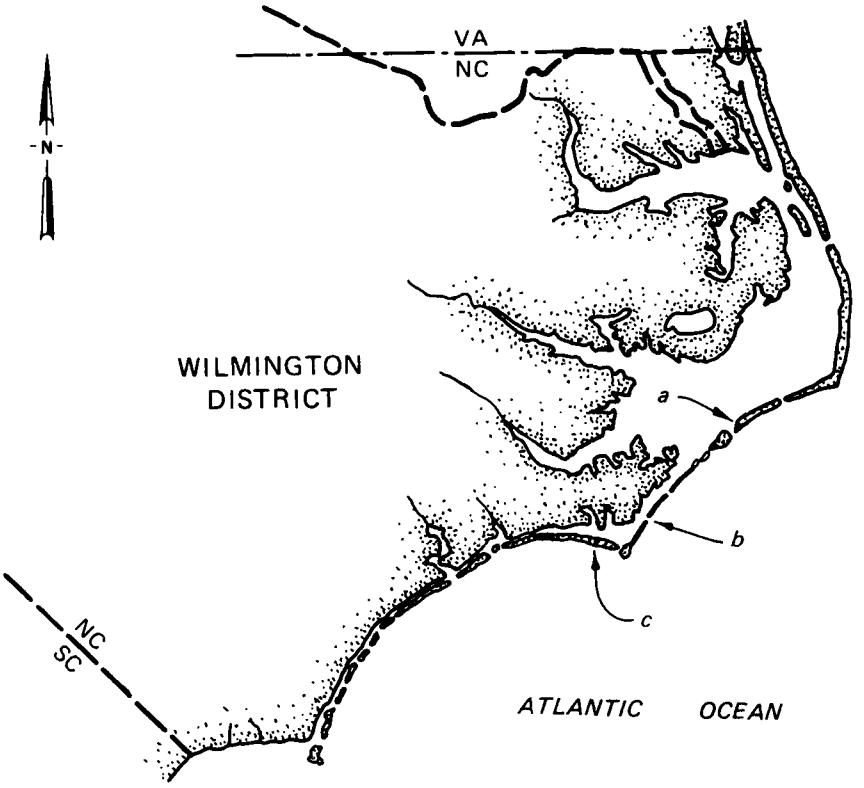

Figure 64. Location Plan 6, Wilmington District

Silver Lake Harbor, North Carolina

79. Site 6a, training wall (jetty). The navigation project, located on Ocracoke Island, provides for training walls on the north and south sides of the entrance channel to the basin in Silver Lake (Figure 65). The north wall is about 800 ft long and the south wall is about 400 ft long. The project entrance channel dimensions are 60 ft wide and 10 ft deep. The mean range of tide is about 1.9 ft.

(NOAA Nautical Chart No. 11550)

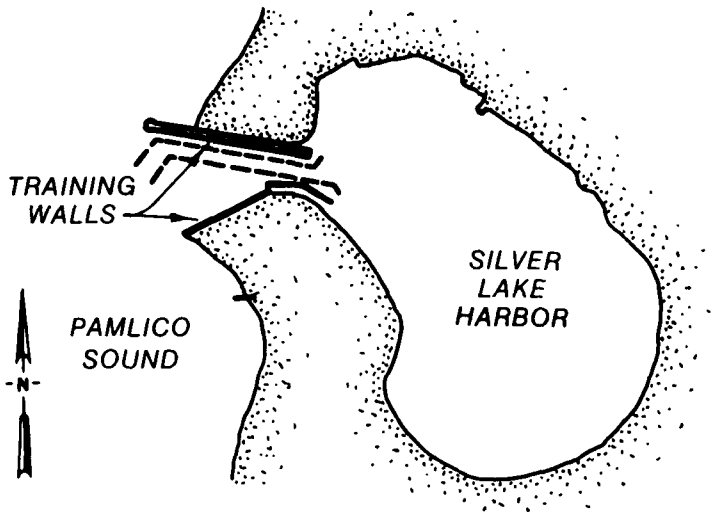

Figure 65. Silver Lake Harbor training walls

Cedar Island Bay, North Carolina

80. Site 6b, jetties. This area is a part of a larger navigation project, Waterway Connecting Pamlico Sound and Beaufort Harbor, North Carolina (Figure 66). The area of interest is the harbor near the Cedar Island Refuge in Cedar Island Bay. The project entrance channel, which is 70 ft wide and 7 ft deep, is protected by two parallel jetties. The jetty on the west side

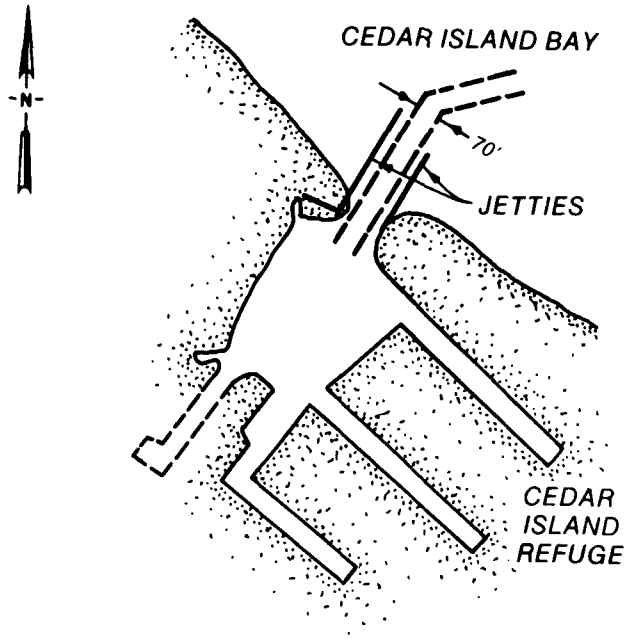

Figure 66. Cedar Island Refuge entrance jetties

is about 300 ft long and the east side jetty is about 200 ft long. The mean range of tide is not indicated.

(NOAA Nautical Chart No. 11550)

Beaufort Harbor, North Carolina

81. Site 6c, training wall (longitudinal dike). The training wall, which performs as a longitudinal dike, is located on the southern tip of Radio Island (Figure 67). The wall runs parallel to the Bulkhead Channel and is about 1,000 ft long. The adjacent navigation project channel is 100 ft wide and 15 ft deep. The mean range of tide is about 2.5 ft.

(NOAA Nautical Chart No. 11545)

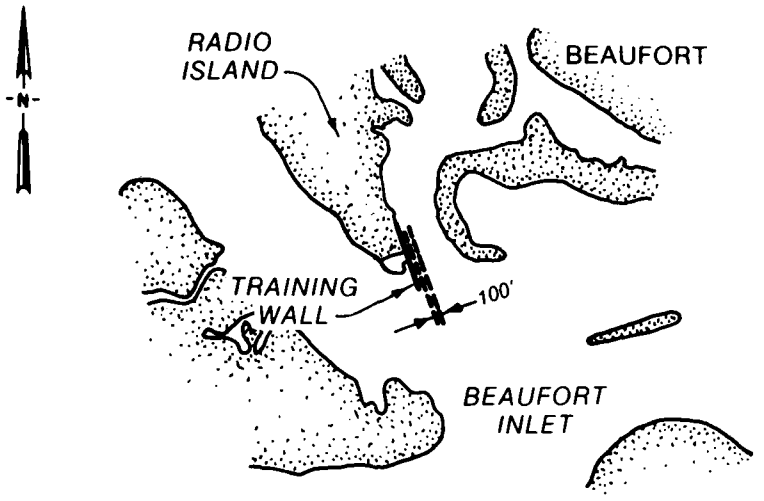

Figure 67. Beaufort Harbor training wall

South Atlantic Division
Charleston District

82. The Charleston District lists five training structures within the District's jurisdiction (US Army Engineer District, Charleston, 1976). The structures include dikes and training walls (Figure 68).

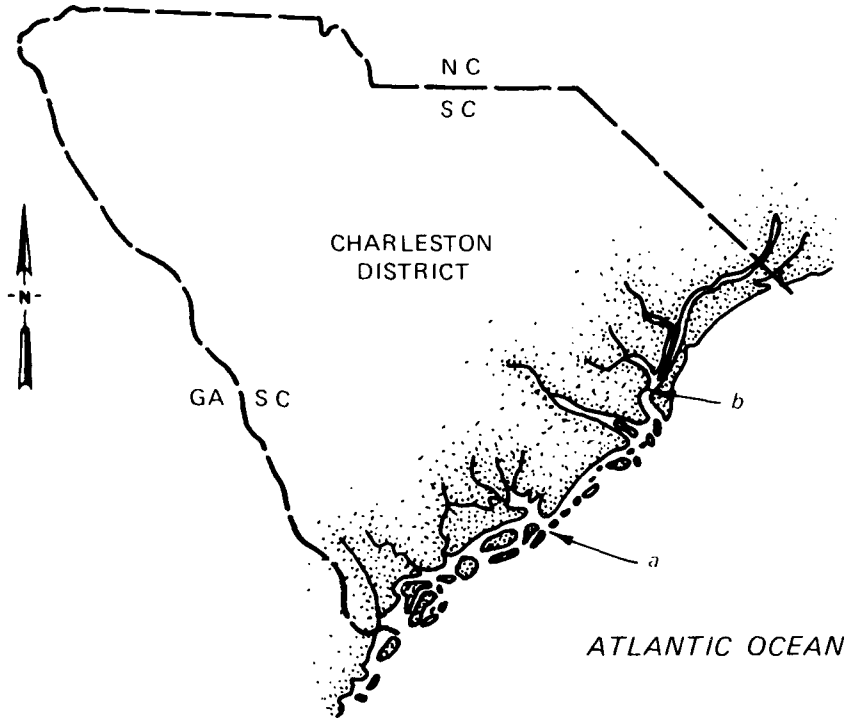

Figure 68. Location Plan 7, Charleston Distict

Charleston Harbor, South Carolina

83. Site 7a, dikes (lateral dikes). Three dikes are located in the Cooper River north of Drum Island between miles 8 and 10 (Figure 69). One of the dikes is on the left bank and one on the right near mile 8, and the third is on the left bank near mile 10. The project channel is about 600 ft wide and 35 ft deep, with deepening to 40 ft authorized in 1976. The mean range of tide is about 5.2 ft.

(NOAA Nautical Chart No. 11524)

Georgetown Harbor, South Carolina

84. Site 7b, training wall (longitudinal dike). The structure is

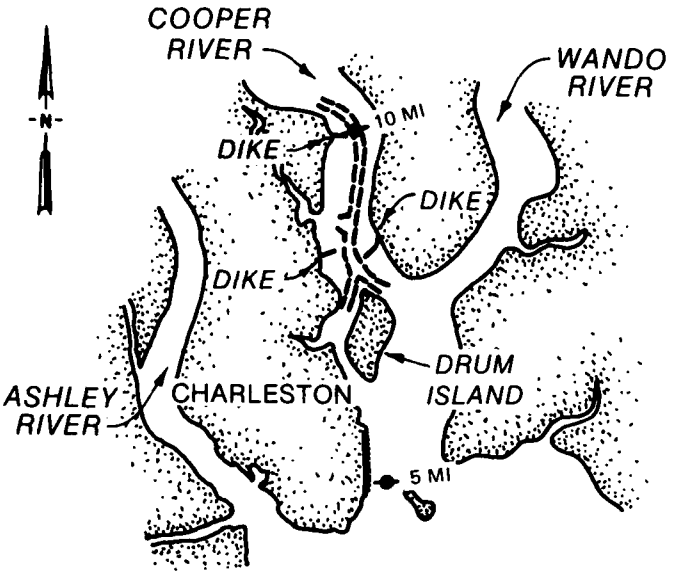

Figure 69. Dikes in Charleston Harbor

located in Winyah Bay south of Georgetown, and divides the west and east navigation channels (Figure 70). The structure begins at a shoaled island and extends north for about 7,500 ft, following a curvature similar to that of the west channel, which is a part of the Atlantic Intracoastal Waterway (AIWW). A shoal approximately 3,000 ft long is indicated opposite and to the east of the eastern channel. The structure also extends about 3,000 ft south from the island. The AIWW, or west channel, is 90 ft wide and 12 ft deep, and the east channel is 400 ft wide and 27 ft deep. The mean range of tide is about 4 ft.

(NOAA Nautical Chart No. 11532)

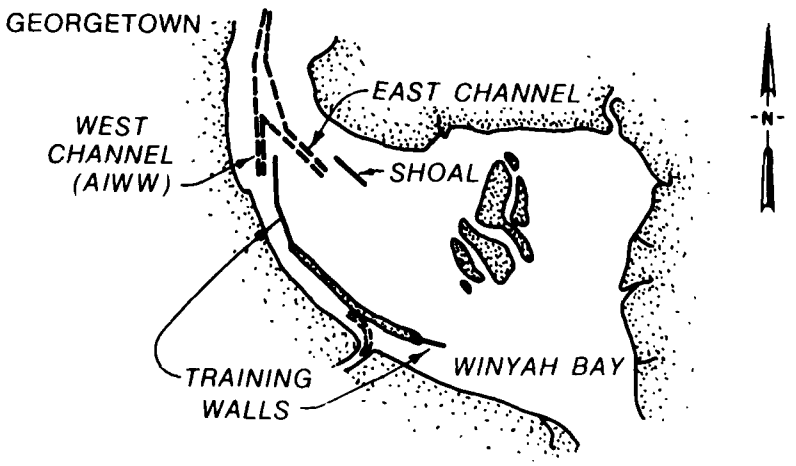

Figure 70. Georgetown Harbor training wall

South Atlantic Division

Savannah District

85. The Savannah District lists a jetty, several dikes, and a tide gate within the District's jurisdiction (US Army Engineer District, Savannah, 1985). The project locations are indicated in Figure 71.

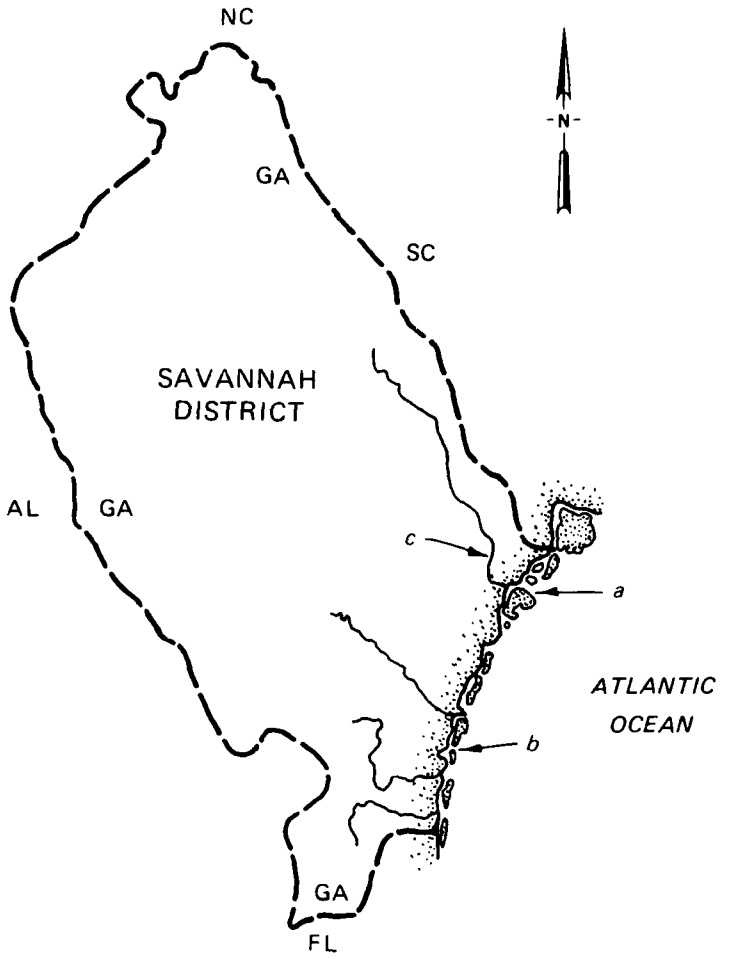

Figure 71. Location Plan 8, Savannah District

Savannah Harbor, Georgia

86. Site 8a, tide gate (barrier dike). The tide gate and sediment basin were authorized to be constructed in the Back River on 27 October 1965 (US 89th Congress, 1st Session). Because this work has been the subject of

Design Memoranda and other publications, the only reference made here is that of location (Figure 72).

(NOAA Nautical Chart No. 11512)

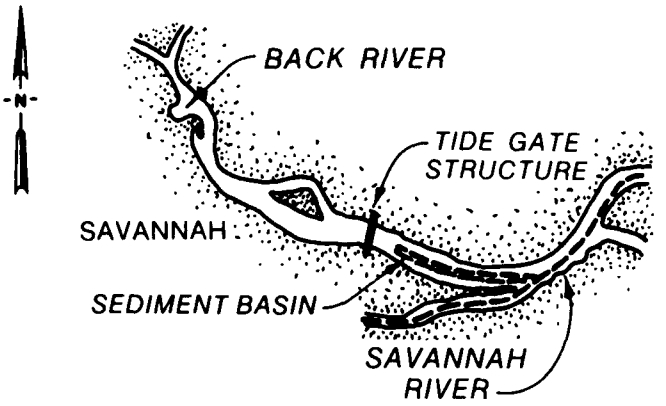

Figure 72. Savannah River tide gate

Brunswick Harbor, Georgia

87. Site 8b, jetty. The structure is located on the southern point of Andrews Island (Figure 73). The mean range of tide is about 7.3 ft in this location.

(NOAA Nautical Chart No. 11506)

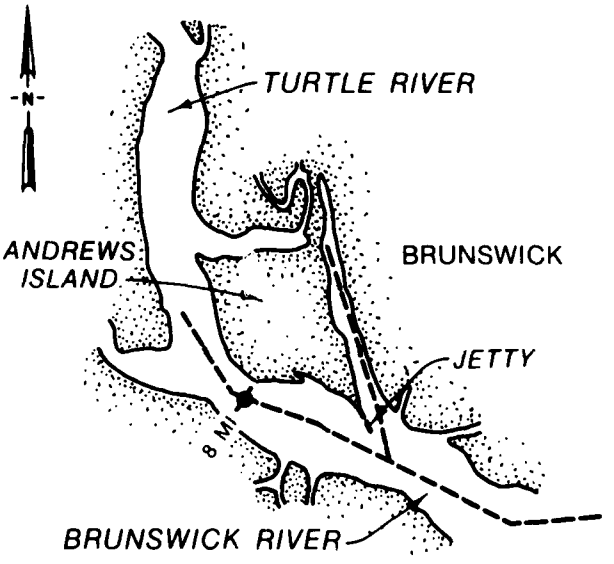

Figure 73. Brunswick Harbor jetty

Savannah River, Georgia

88. Site 8c, dikes (longitudinal and lateral dikes). Four dikes have been constructed in this reach of the Savannah River (Figure 74). Two longitudinal stone dikes were constructed near the Interstate 95 bridge at about mile 27.5, and two lateral timber pile dikes constructed at about mile 30.5.

(NOAA Nautical Chart No. 11514)

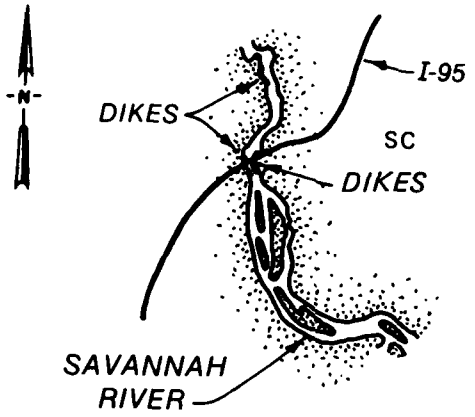

Figure 74. Dikes in the Savannah River

South Atlantic Division
Jacksonville District

89. The Jacksonville District lists 12 training structures of various types within the District's jurisdiction (US Army Engineer District, Jacksonville, 1979). The project locations are shown in Figure 75.

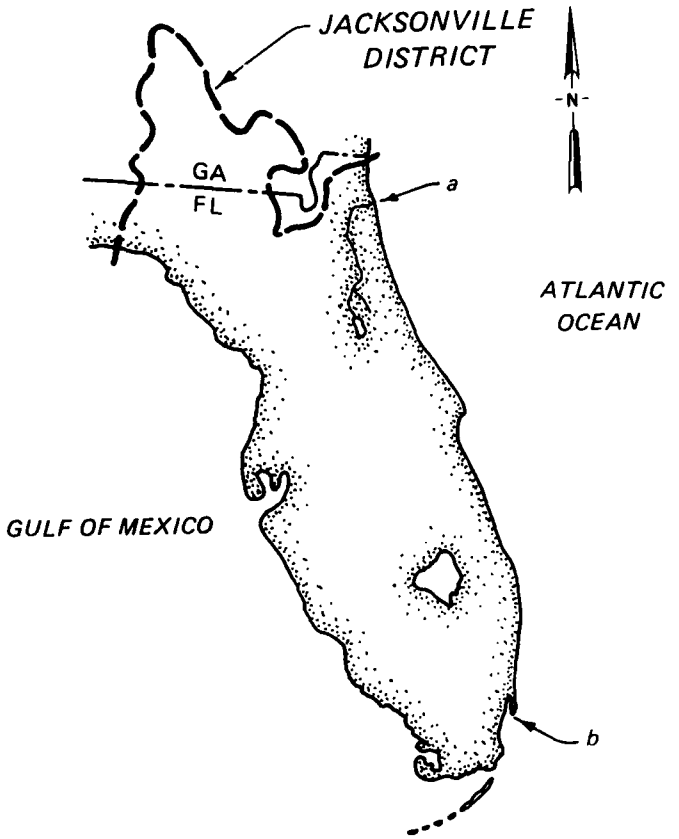

Figure 75. Location Plan 9, Jacksonville District

Jacksonville Harbor, Florida

90. Site 9a, training walls (longitudinal dikes). The control structure and a dike are located at mile 10 of the St. Johns River (Figure 76). The longitudinal dike was constructed parallel to the channel and on an island. The control structure is located in an opening to Mill Cove, in line with the dike. Six training walls and a jetty protect the navigation channel along river bends, but are not noted specifically in the report.

(NOAA Nautical Chart No. 11491)

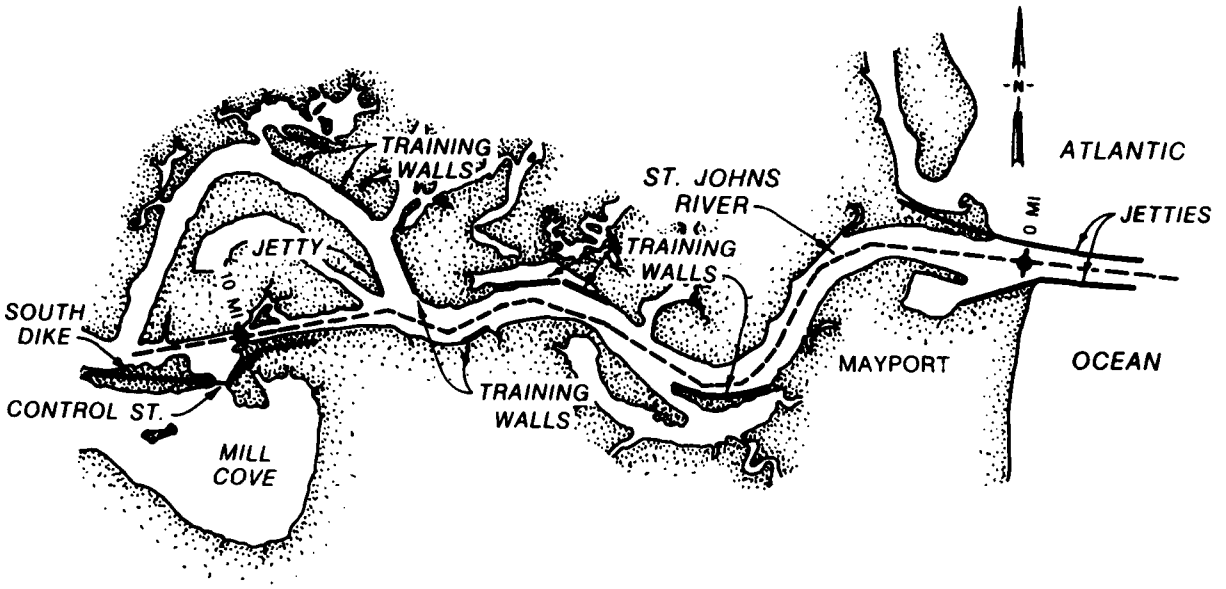

Figure 76. Training structures in the St. Johns River estuary

Coral Gables Waterway,
Miami Harbor, Florida

91. Site 9b, jetty. The structure is located at the Biscayne Bay entrance to the Coral Gables Waterway (Figure 77). Although not specifically noted on the map, the structure is shown on the north bank extending southeast into the bay about 900 ft.

(NOAA Nautical Chart No. 11468)

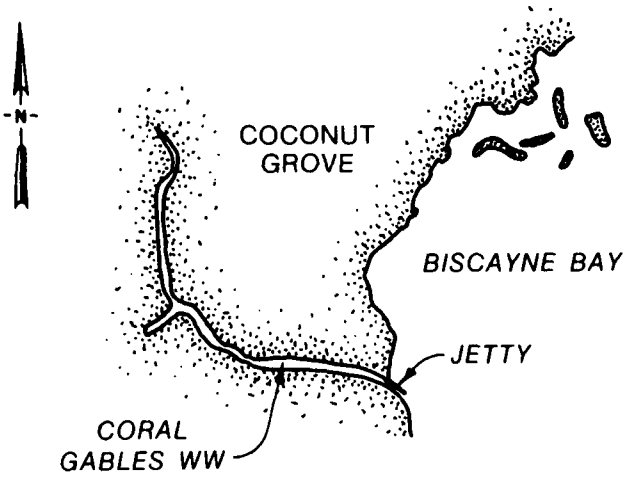

Figure 77. Coral Gables Waterway entrance jetty

South Atlantic Division

Mobile District

92. The Mobile District lists three jetties within the District's jurisdiction (US Army Engineer District, Mobile, 1982). The project locations are shown in Figure 78.

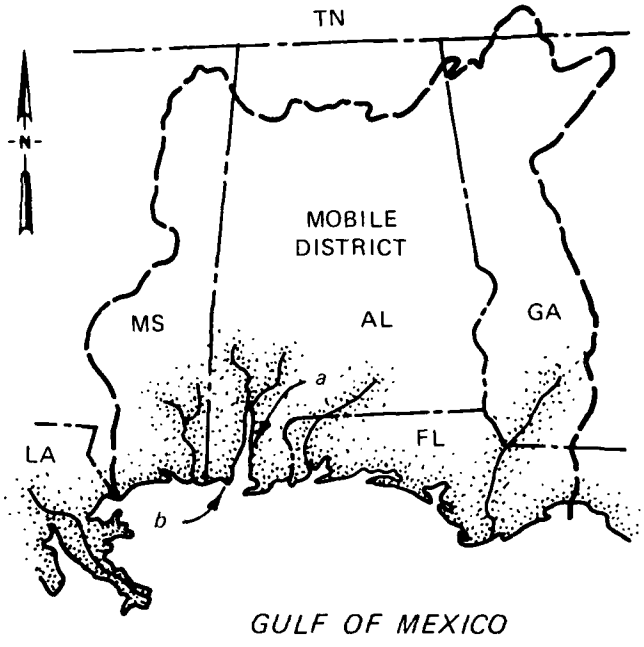

Figure 78. Location Plan 10, Mobile District

Fly Creek, Fairhope, Alabama

93. Site 10a, jetties. Two concrete and steel jetties were constructed to protect the harbor entrance channel (Figure 79). The north jetty is about 390 ft long and the south jetty is about 150 ft long, both extending west into Mobile Bay. The project navigation channel is 80 ft wide and 6 ft deep. The mean range of tide is 1.3 ft.

(NOAA Nautical Chart No. 11376)

Dauphin Island Bay, Alabama

94. Site 10b, jetty. The navigation project is located on the eastern tip of Dauphin Island in Mobile Bay, near Fort Gaines (Figure 80). The stone jetty, which protects the project entrance channel leading to Dauphin Island

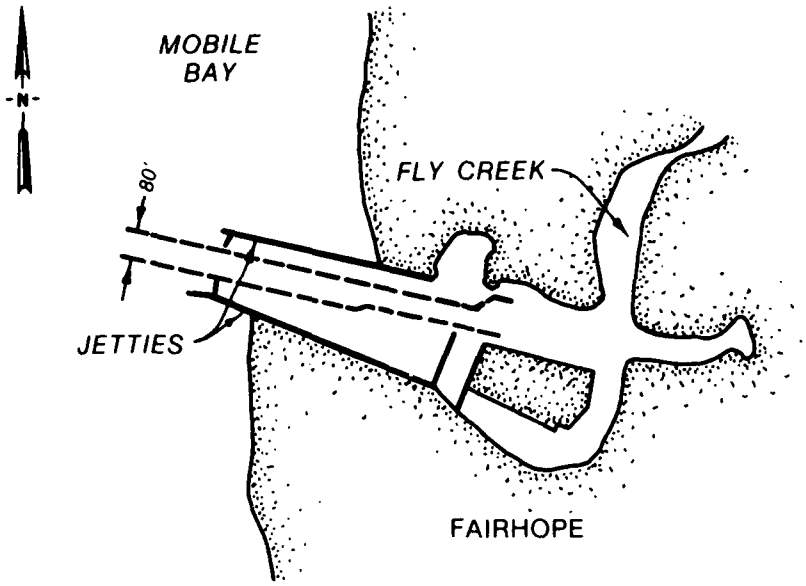

Figure 79. Fly Creek entrance jetties

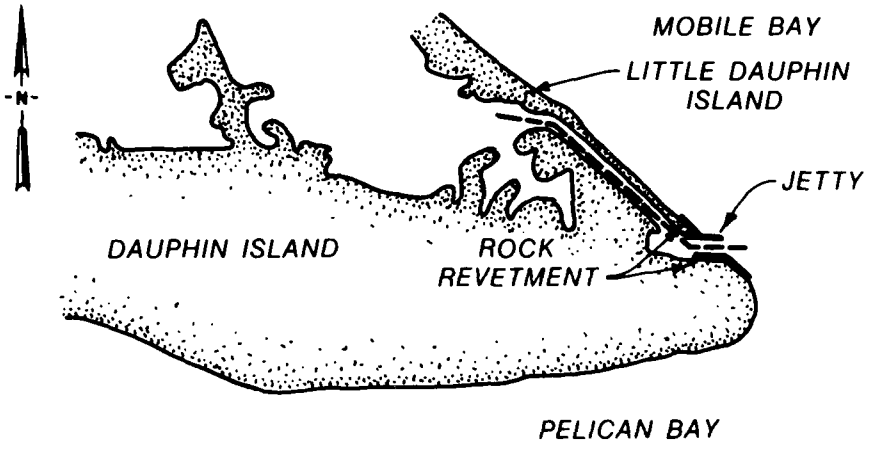

Figure 80. Dauphin Island Bay entrance jetty

Bay, is about 300 ft long. The project channel is 150 ft wide and 7 ft deep. The mean range of tide is 1.1 ft.

(NOAA Nautical Chart No. 11378)

Lower Mississippi Valley Division

New Orleans District

95. The New Orleans District lists numerous dikes in the Passes region of the Mississippi River (US Army Engineer District, New Orleans, 1982) (Figure 81).

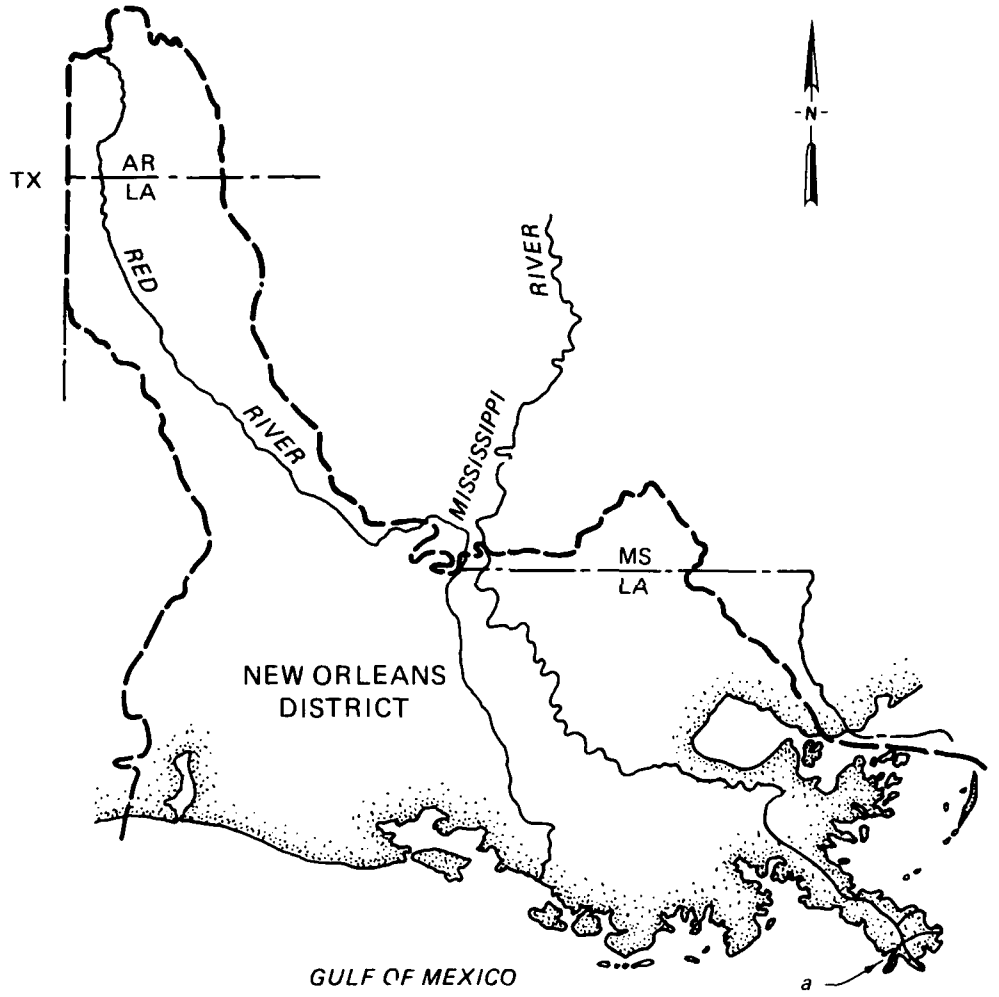

Figure 81. Location Plan 11, New Orleans District

Mississippi River, Louisiana

96. Numerous structures have been constructed in this estuary to help control shoaling in the navigation channel, including the following:

a. Site 11a, sills (submerged barrier dikes). Two submerged deflecting dikes were located within the entrance to Pass a Loutre (Figure 82); however, they were abandoned since they proved to be ineffective.

b. Site 11a, dikes (lateral dikes). Several dikes are located on the northeast bank of the Mississippi River between river miles 0 and 3.5 near the Head of Passes region (Figure 82).

c. Site 11a, headland structures (longitudinal dikes). Two headland dikes, constructed of timber piles, are located at the entrance of South Pass (Figure 82).

d. Site 11a, spur dikes (lateral dikes). Numerous timber pile dikes have been constructed in Southwest Pass and South Pass (Figure 82). Only the locations will be noted since current information is available.

(NOAA Nautical Chart No. 11361)

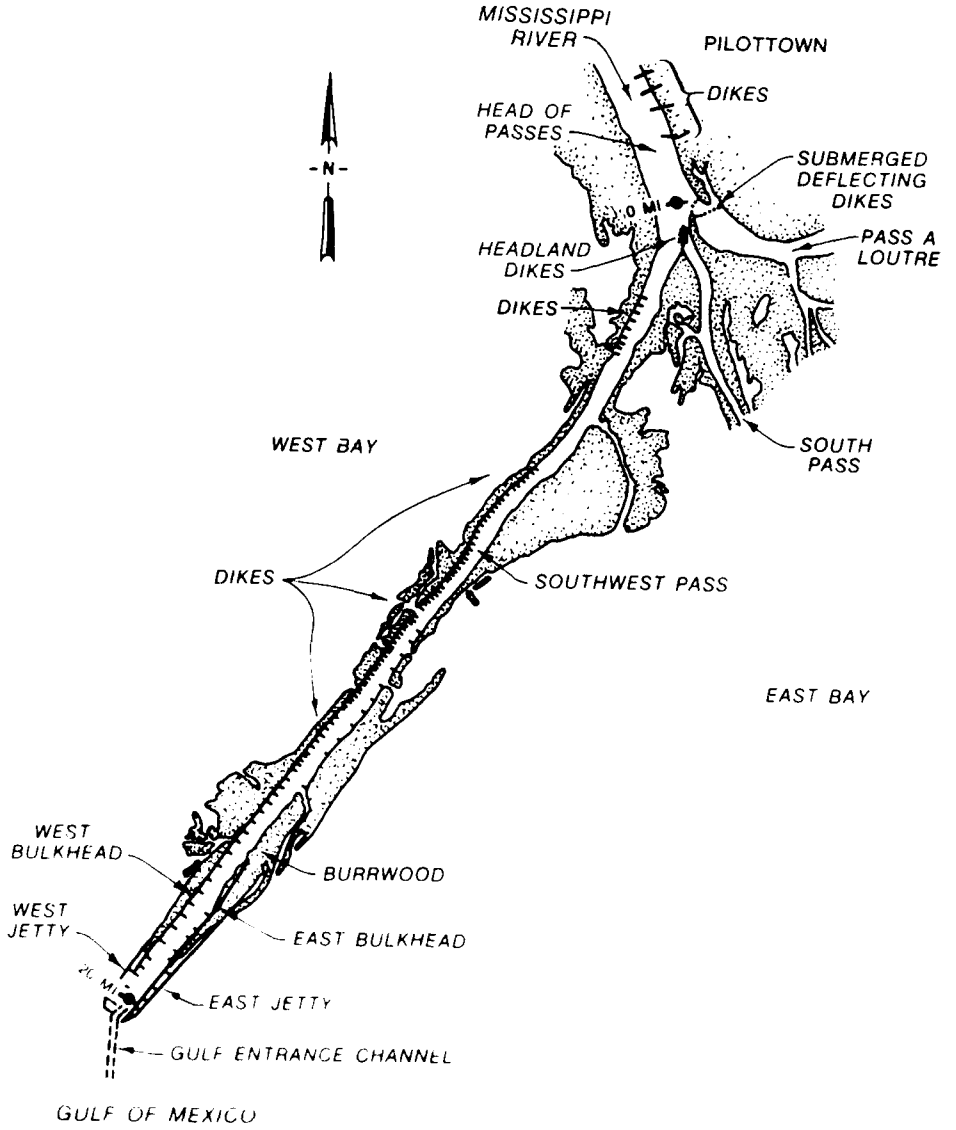

Figure 82. Training structures on the Mississippi River, South and Southwest Passes

Southwestern Division
Galveston District

97. The Galveston District lists 12 estuarine training structures within the District's jurisdiction (US Army Engineer District, Galveston, 1977). The locations of the projects are shown in Figure 83.

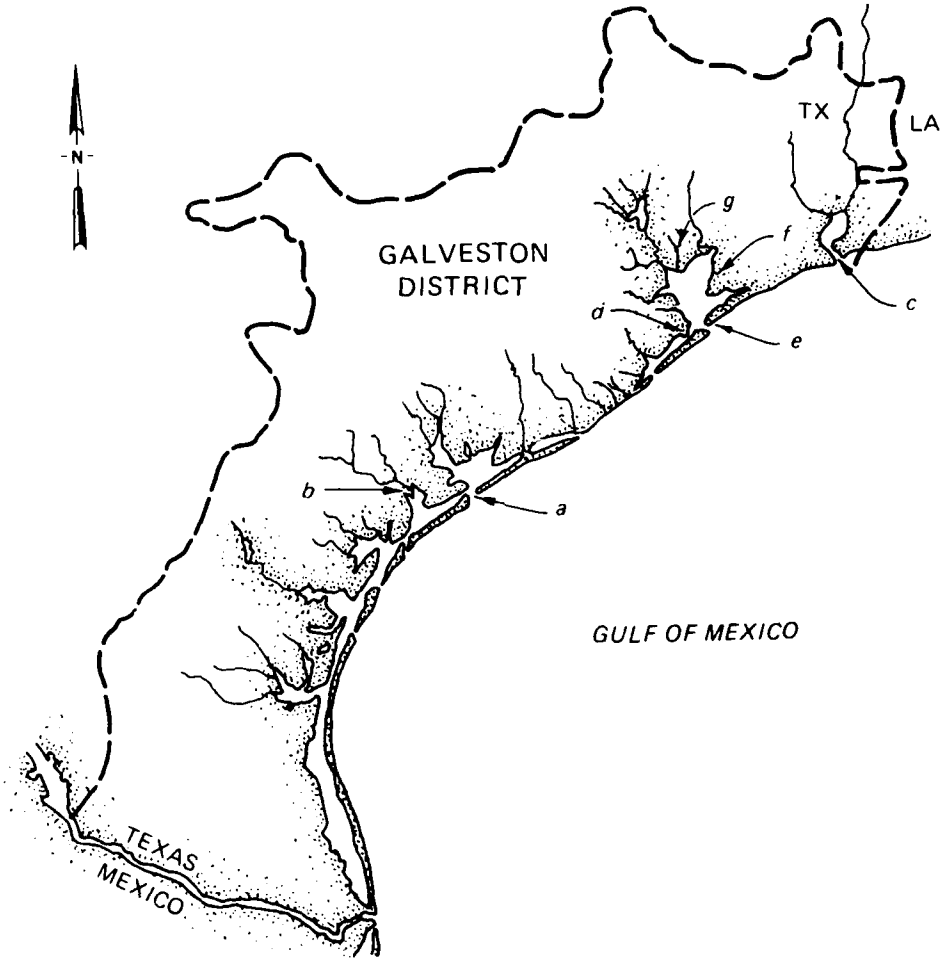

Figure 83. Location Plan 12, Galveston District

Port O'Connor, Texas

98. Site 12a, dikes (jetties). Two dikes that function as jetties protect the entrance channel of the Gulf Intracoastal Waterway (GIWW) in Matagorda Bay (Figure 84). The dikes consist of steel sheetpiling with shore and scour protection for 1,000 ft along the entrance, and rubble-mound dikes with a steel sheet core extending about 1,000 ft into the bay. The project

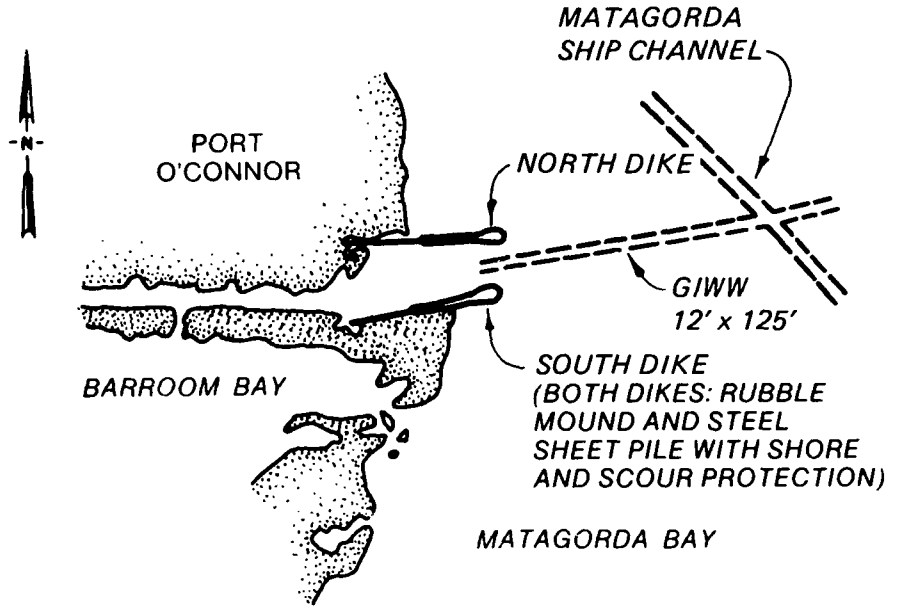

Figure 84. Dikes in Matagorda Bay

navigation channel in this area is 125 ft wide and 12 ft deep. The mean range of tide is about 2 ft.

(NOAA Nautical Chart No. 11317)

San Antonio Bay, Texas

99. Site 12b has been disqualified from the inventory.

100. Site 12c has been disqualified from the inventory.

Texas City Dike, Texas City, Texas

101. Site 12d, dike (barrier dike). The navigation project, which is located in south Galveston Bay, provides for a dike to reduce shoaling in the Texas City Channel (Figure 85). The dike, which runs parallel to and north of the channel, consists of a timber dike 28,200 ft long and a rubble-mound dike 27,600 ft long parallel to and south of the timber dike. The project channel in this area is 400 ft wide and 40 ft deep. The mean range of tide is about 1.3 ft.

(NOAA Nautical Chart No. 11324)

Port Bolivar, Texas

102. Site 12e, dike (jetty). The navigation project is located at the

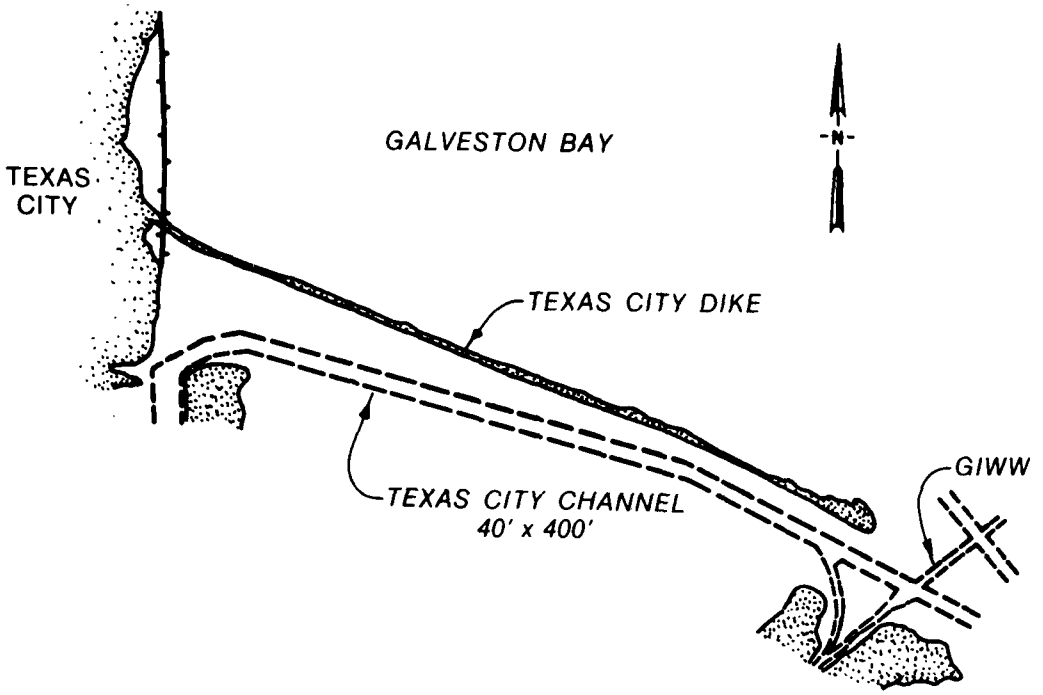

Figure 85. Texas City Dike, Texas City

east entrance of the GIWW into Galveston Bay (Figure 86). A steel sheet-pile and stone dike, which acts as a combination of a jetty and longitudinal dike, protects the northern point. The dike extends about 1,000 ft into the bay to

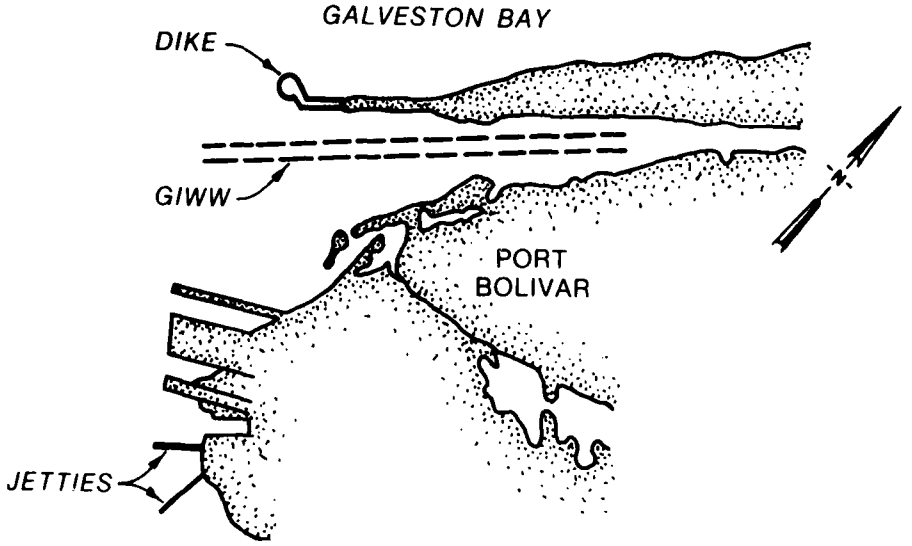

Figure 86. Dike in Galveston Bay near Port Bolivar

the southwest. The project channel is 300 ft wide and 12 ft deep. The mean range of tide is about 1 ft.

(NOAA Nautical Chart No. 11324)

Trinity Bay (Channel to Liberty near Double Bayou, Texas)

103. Site 12f, earth dam (barrier dike). An earth dam is indicated in the Channel to Liberty, in northeast Trinity Bay near Anahuac (Figure 87). The navigation project channel dimensions in this area are 150 ft wide and 9 ft deep. The mean range of tide is about 0.6 ft in this area of Trinity Bay.

(NOAA Nautical Chart No. 11326)

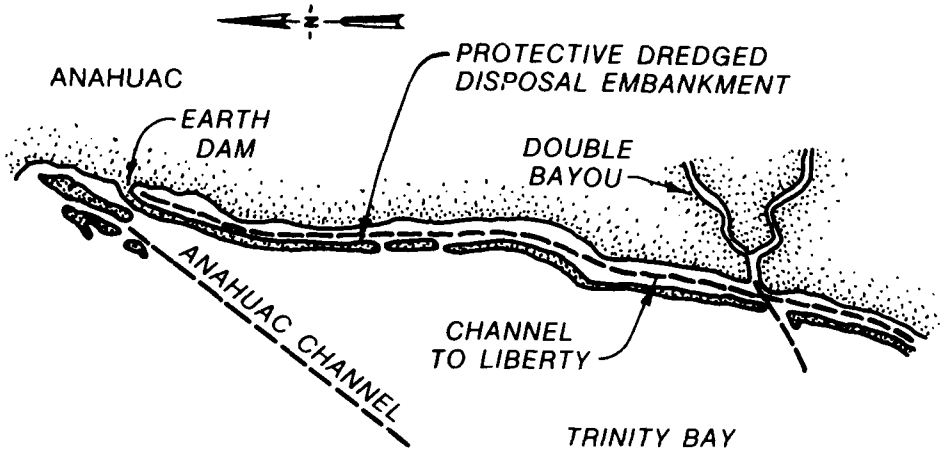

Figure 87. Earth dam in the Channel to Liberty

Cedar Bayou, Texas

104. Site 12g, submerged jetties. The navigation project is located in Galveston Bay (Figure 88). Submerged brush and stone jetties are indicated in the entrance of the old Cedar Bayou Channel which was completed in 1931. The jetties extend from mile 0 in the bay to mile 0.7 at the old entrance of the Cedar Bayou Channel. Realignment in this area was completed in 1975. The new project channel in this area is 100 ft wide and 10 ft deep. The mean range of tide is 0.6 ft.

(NOAA Nautical Chart No. 11328)

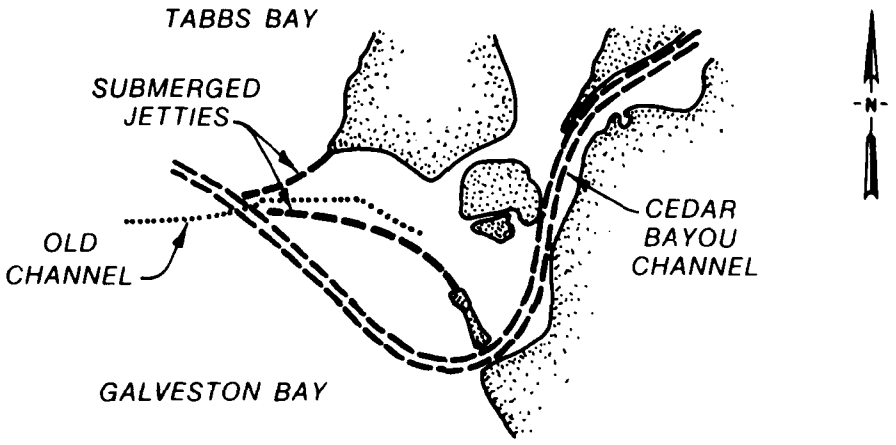

Figure 88. Submerged jetties in the Cedar Bayou Channel

South Pacific Division

San Francisco District

105. The San Francisco District lists several training structures, including a training wall, groin, and jetties (US Army Engineer District, San Francisco, 1984). The project locations are indicated in Figure 89.

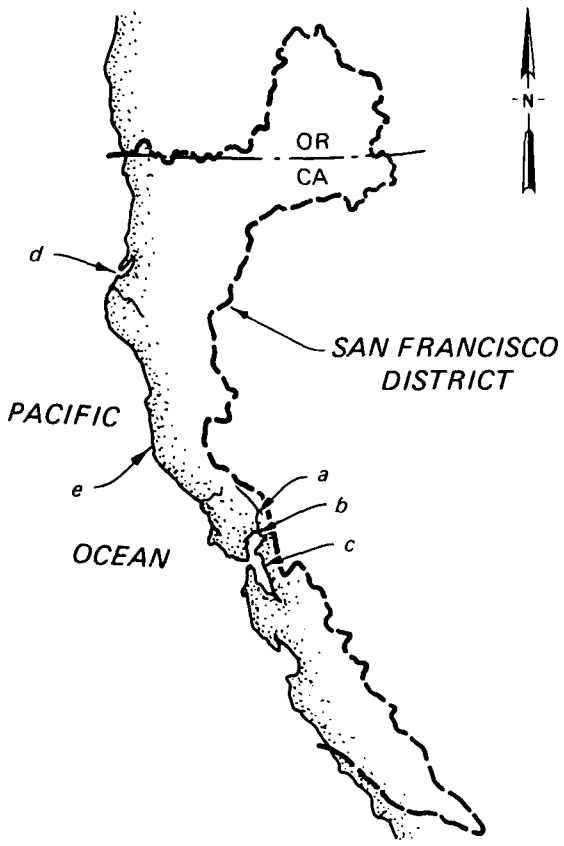

Figure 89. Location Plan 13,
San Francisco District

Napa River, California

106. Several structures are noted for this project, including the following:

a. Site 13a, dikes (jetties and lateral dikes). Located in upper San Pablo Bay, two jetties protect the mouth of the river (Figure 90).

b. Site 13a, dike (longitudinal dike). The navigation project covers the channel from mile 0 at Vallejo to mile 16 in Napa (Figure 90). The description calls for dikes and revetments in "difficult areas"; however, it does not indicate where

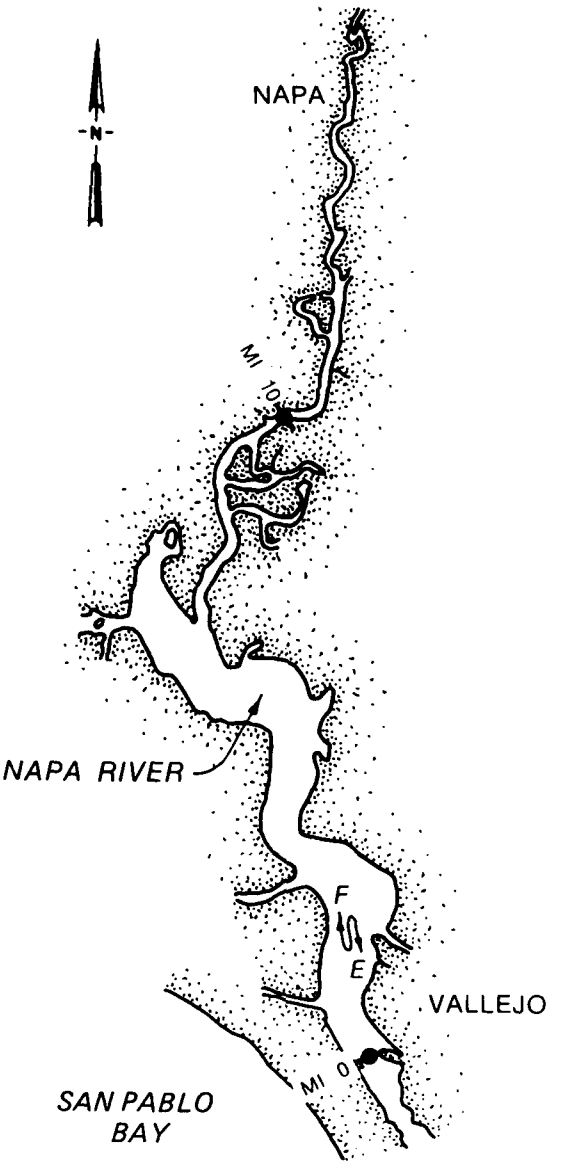

Figure 90. Napa River, California

these areas are. One longitudinal dike is indicated in upper San Pablo Bay.

(NOAA Nautical Chart No. 18654)

Richmond Harbor, San Francisco Bay, California

107. Site 13b, training wall (longitudinal dike). The Richmond Outer Harbor Training Wall extends 10,000 ft west from Brooks Island in San Francisco Bay (Figure 91). The wall was constructed in 1923 and later extended in 1931 to the present length. Subsidence was corrected by rehabilitation of the

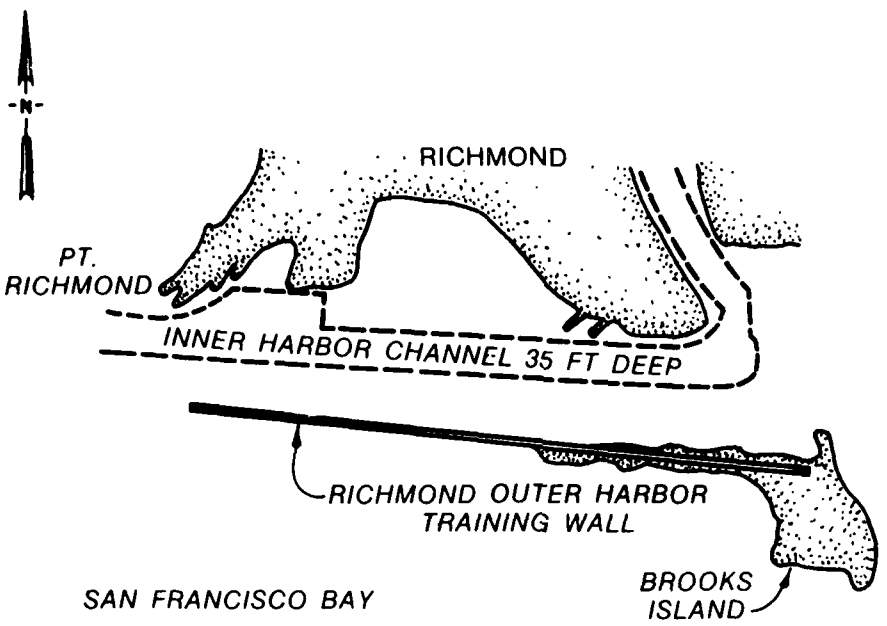

Figure 91. The Richmond Outer Harbor Training Wall

outer 3,000 ft in 1967 and 1985. The wall was constructed to direct tidal currents, lessen channel dredging, and protect vessels in the harbor from southerly storms. The project inner harbor channel varies from 500 to 600 ft wide and is 35 ft deep. The mean range of tide is 5.8 ft.

(NOAA Nautical Chart No. 18649)

Oakland Harbor,
San Francisco Bay, California

108. Site 13c, jetties. The navigation project provides for two rubble-mound parallel jetties to protect the inner harbor entrance channel (Figure 92). The north jetty is 9,500 ft long and the south jetty is 12,000 ft long. The project channel is 600 ft wide and 35 ft deep. The mean range of tide is about 6.3 ft.

(NOAA Nautical Chart No. 18650)

Humboldt Harbor and Bay, California

109. Site 13d, groin and breakwater (barrier dike). The project is a special shore protection demonstration study which provides for a groin and a rubble-mound breakwater to protect the Buhne Point Shore from erosion (Figure 93). The groin (timber, rock, and concrete diaphragm) is 1,825 ft long and has reduced maintenance dredging in the adjacent Field Landing Channel.

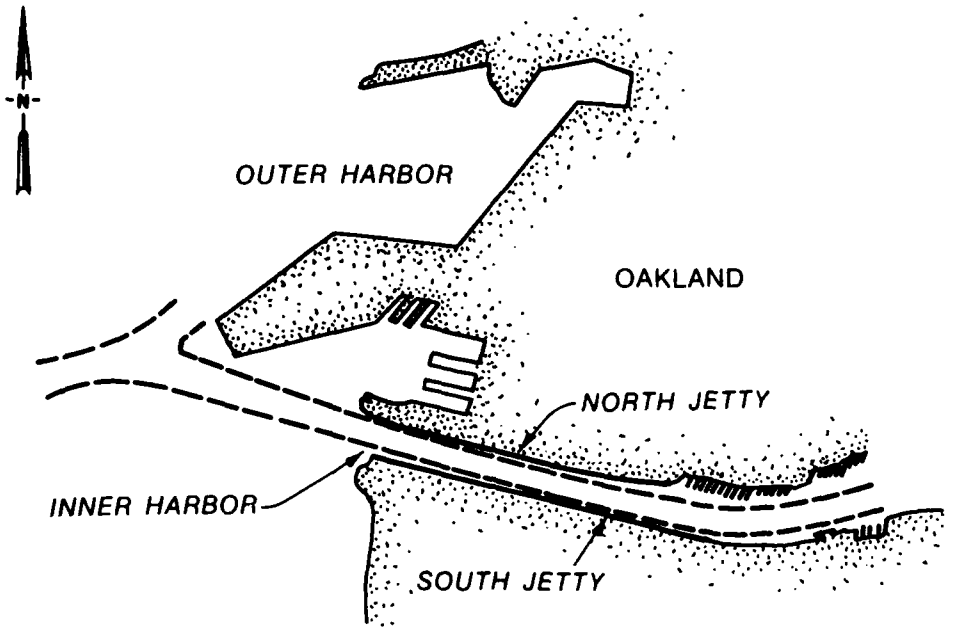

Figure 92. Jetties in Oakland Harbor

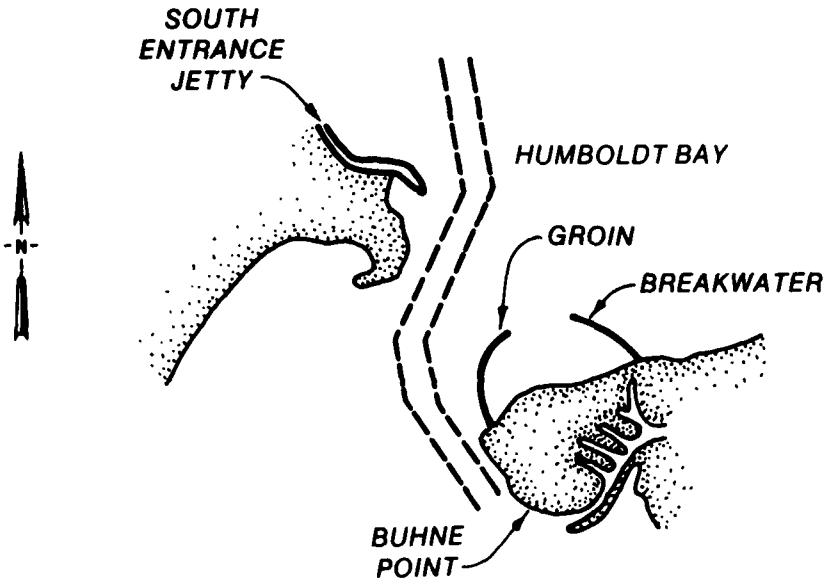

Figure 93. Groin and breakwater at Buhne Point, Humboldt Bay

The rubble-mound breakwater is 1,100 ft long. The mean range of tide is about 6.4 ft.

(NOAA Nautical Chart No. 18622)

Noyo River and Harbor, California

110. Site 13e, jetties and walls (jetties). The project provides for two concrete jetties and walls to protect the entrance channel (Figure 94). The north jetty and wall are 620 ft and the south jetty (wall) is 234 ft in length. The project channel is 100 to 150 ft wide and 10 ft deep. The mean range of tide is about 5.8 ft.

(NOAA Nautical Chart No. 18626)

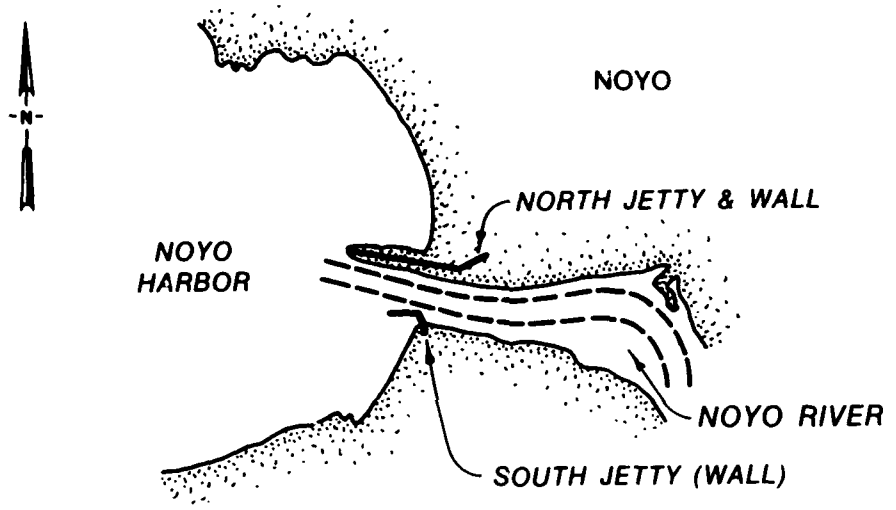

Figure 94. Entrance jetties in Noyo Harbor

North Pacific Division
Portland District

111. The Portland District lists several hundred training structures within the District's jurisdiction (US Army Engineer District, Portland, 1973). The structures include mainly timber pile dikes with a few stone dikes and jetties (Figure 95).

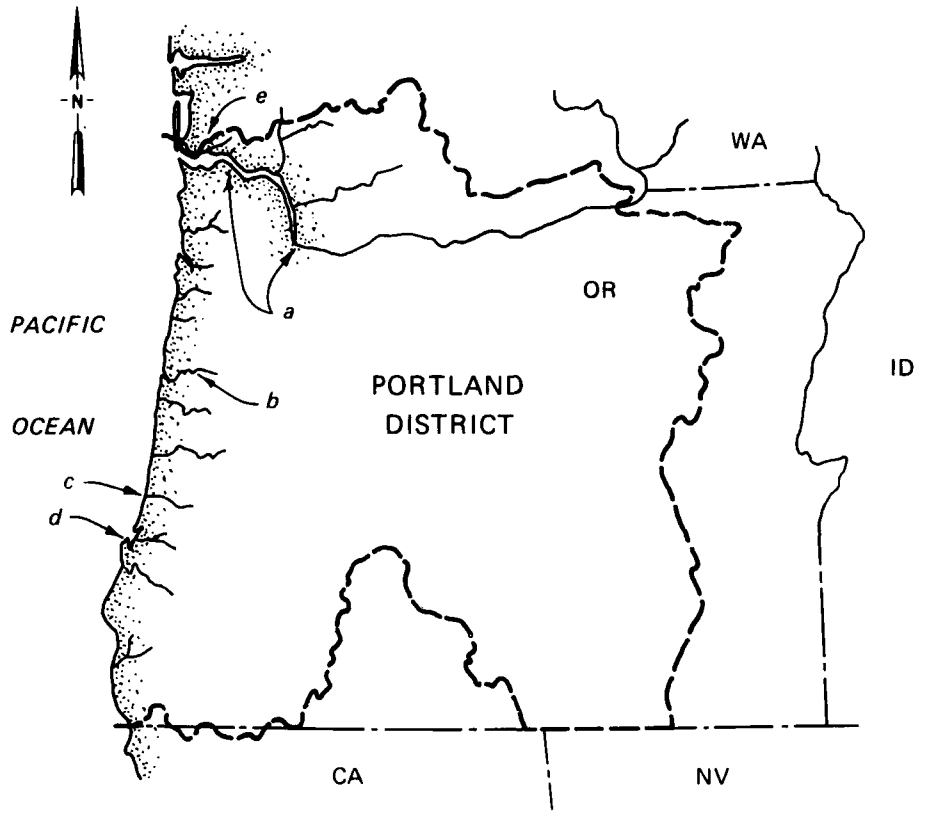

Figure 95. Location Plan 14, Portland District

Columbia River, Oregon

112. The following structures are noted for this project:

a. Site 14a.1, dikes (lateral dikes). The navigation project, Oregon Slough, is located at river mile 102 where the channel serves North Portland Harbor (Figure 96). Nine spur dikes are indicated on north and south banks of the slough between miles 0 and 3. The project channel is 200 ft wide and 20 ft deep. The mean range of tide is 2 ft at low stage.

(NOAA Nautical Chart No. 18526)

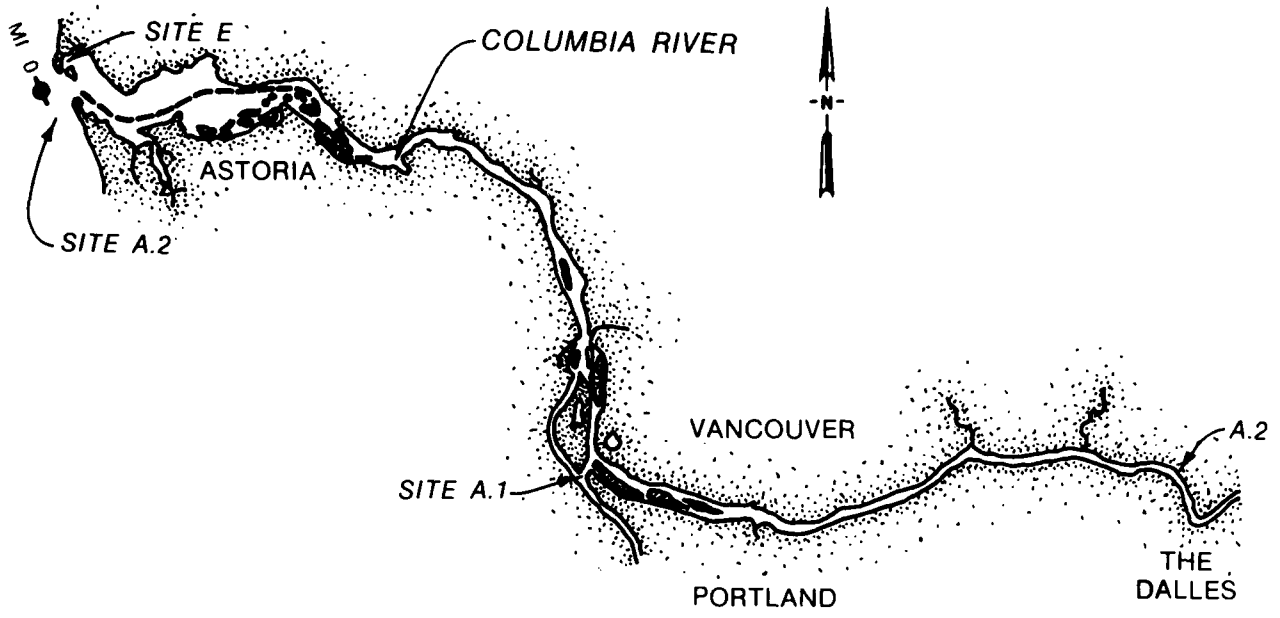

Figure 96. General location of dikes on the Columbia River

b. Site 14a.2, lower Columbia River dikes (lateral dikes). The area covered by this navigation project extends from mile 0 at the mouth of the Columbia River, to mile 145 at The Dalles, Oregon, and includes about 246 timber pile dikes (Figure 96). Only the general location is given in this inventory for these structures.

(NOAA Nautical Chart Nos. 18521 and 18531)

Yaquina River near Toledo, Oregon

113. Site 14b, submerged dikes (lateral dikes). The navigation project provides for two half-tide dikes located near river miles 11 and 13.5 (Figure 97). The project channel in this area is 150 ft wide and 10 ft deep. The mean range of tide is about 8 ft.

(NOAA Nautical Chart No. 18581)

Umpqua River, Oregon

114. Site 14c, training jetty (longitudinal dike). The project includes a training jetty, about 3,500 ft long on the south side of the entrance (Figure 98). Completed in 1951, the jetty begins at mile 0 and curves to the

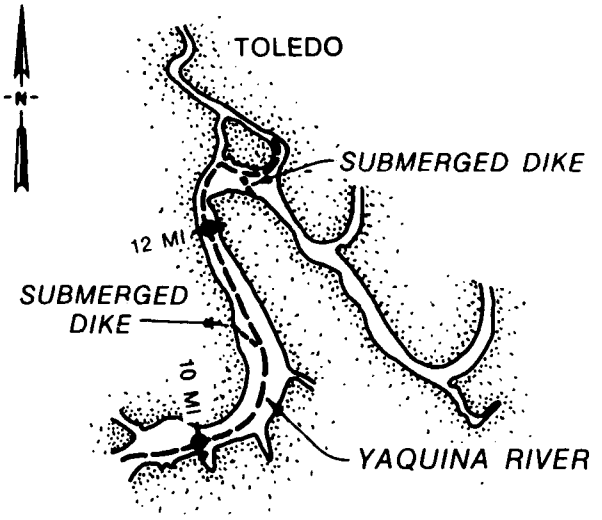

Figure 97. Submerged dikes in the Yaquina River

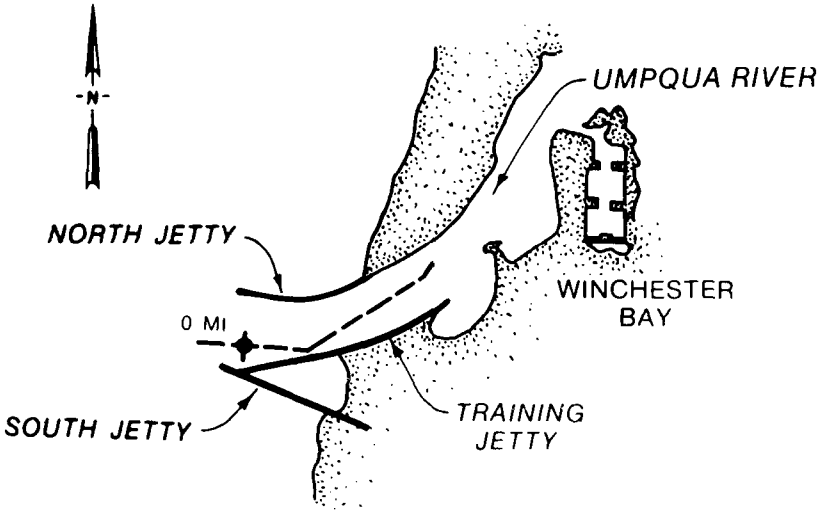

Figure 98. Umpqua River training jetty

northeast parallel to and south of the channel. The project navigation channel is 200 ft wide and 22 ft deep. The mean range of tide is 6.9 ft.

(NOAA Nautical Chart No. 18584)

Coos Bay, Oregon

115. Site 14d, dikes (lateral dikes). The project includes five dikes that are located on the northern bank between miles 6 and 7.5 (Figure 99). The navigation channel in this area is 300 ft wide and 35 ft deep. The

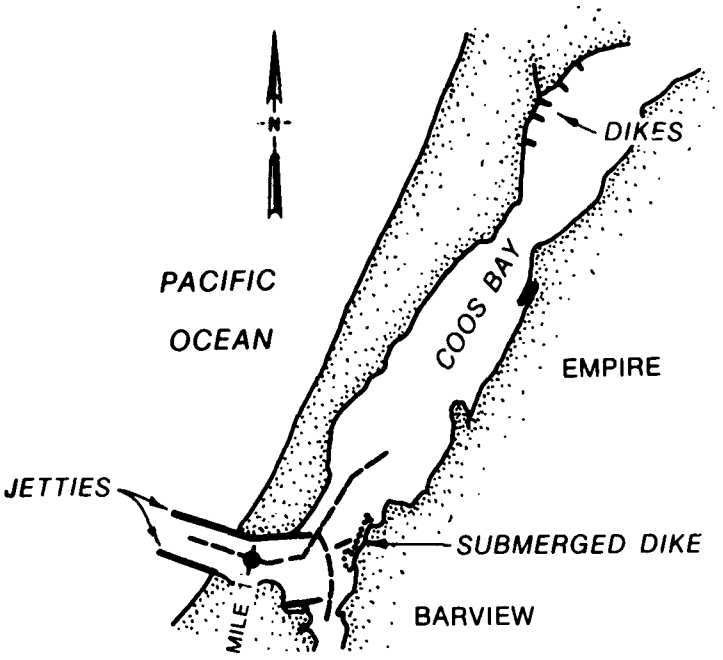

Figure 99. Dikes in Coos Bay

project also includes a submerged dike near mile 2 on the east bank (north of Barview). The project channel extension in this area is 150 ft wide and 10 ft deep. The mean range of tide at the entrance is about 7 ft.

(NOAA Nautical Chart No. 18587)

Baker Bay, Oregon

116. Site 14e, dikes (lateral dikes). The navigation project included the construction of four spur dikes on the western side of Sand Island in the channel leading to the Port of Ilwaco (Figure 96). The western project channel is 150 ft wide and 10 ft deep. The mean range of tide is about 8 ft.

(NOAA Nautical Chart No. 18521)

North Pacific Division

Seattle District

117. The Seattle District lists almost 20 training structures within the District's jurisdiction (US Army Engineer District, Seattle, 1982). The structures include dikes, jetties, walls, and a sill (Figure 100). (Several structures are in poor condition and may no longer exist.)

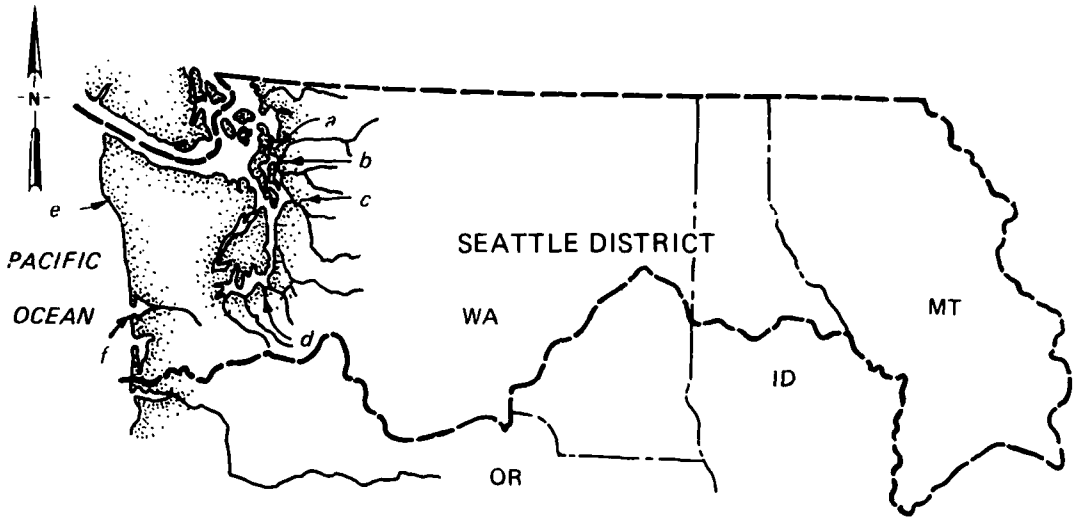

Figure 100. Location Plan 15, Seattle District

Swinomish Channel, Washington

118. Site 15a, jetties and dikes (barrier and longitudinal dikes). The Swinomish Channel navigation project provides for a 100-ft-wide by 12-ft-deep channel from Saratoga Passage, in Skagit Bay, to deep water in Padilla Bay (Figure 101). The Saratoga entrance jetties extend from land at about mile 2 with the north jetty projecting southwest to about mile 1.5 and the south jetty reaching almost to mile 0. Also located in the entrance at mile 3 are two longitudinal dikes paralleling the project channel on opposite sides. The mean range of tides in Skagit Bay is about 7 ft.

(NOAA Nautical Chart No. 18427)

Skagit River, Washington

119. Site 15b, sill, closure and training dikes (barrier and longitudinal dikes). The navigation project provides an entrance channel to the branched network of the Skagit River (Figure 102). The construction of the

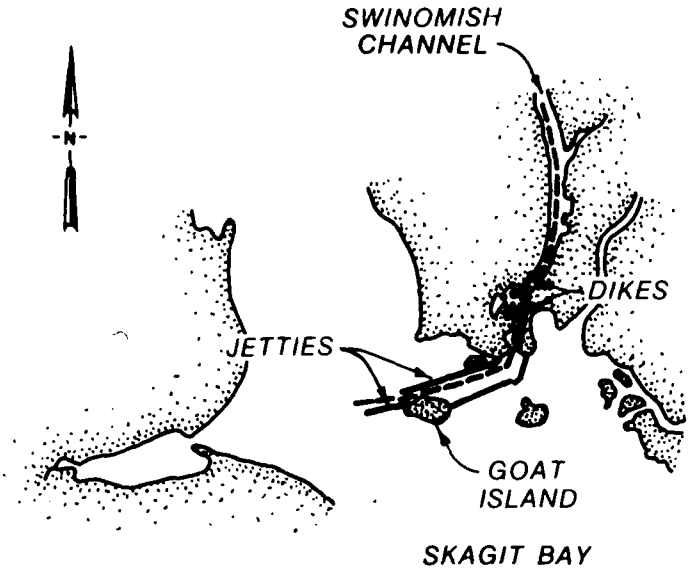

Figure 101. Training structures in the Swinomish Channel

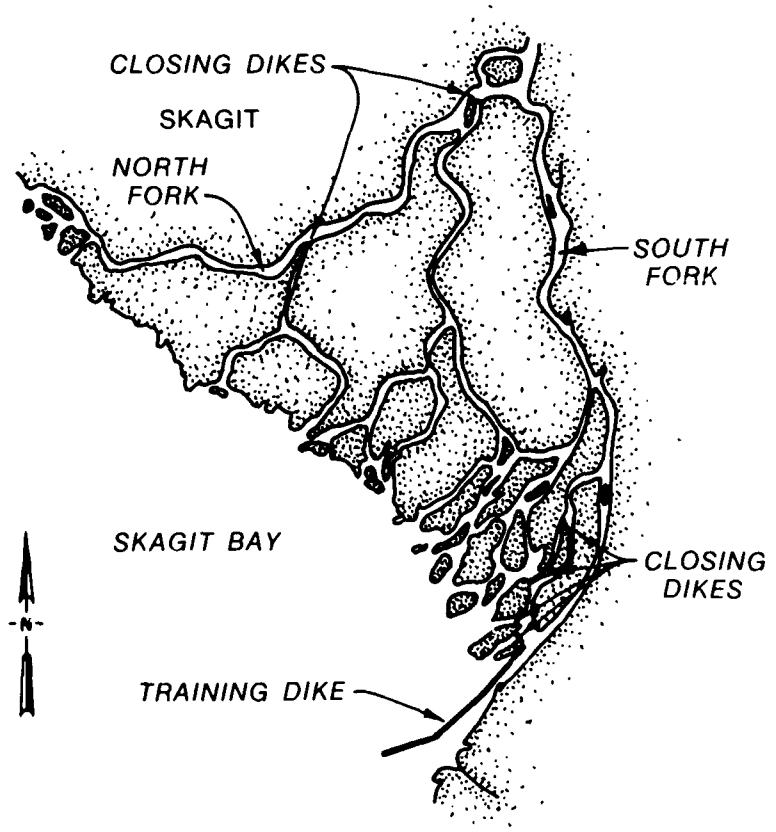

Figure 102. Training structures in the Skagit River

10,450-ft-long training dike at the entrance, a mattress sill near the head of the North Fork, and several closure dikes was completed in 1911. The mattress sill became a hazard to navigation and was removed. The remaining structures are noted to be in poor condition. The training dike was not completed to the authorized length of 16,000 ft. Portions of the project were deauthorized in 1978. The mean range of tide is about 8 ft.

(NOAA Nautical Chart No. 18400)

Snohomish River, Everett Harbor, Washington

120. Site 15c, training dikes, spur dikes, and pile wall (longitudinal and lateral dikes). The navigation project provides for a training dike parallel to the entrance channel (Figure 103). The dike extends 12,550 ft north from mile 0, and ends at the Gap with a 400-ft-long spur dike. Completed in 1963, the lower 3,250 ft required rehabilitation in 1974. Other structures authorized in the project include a spur dike, 1,410 ft long, and a

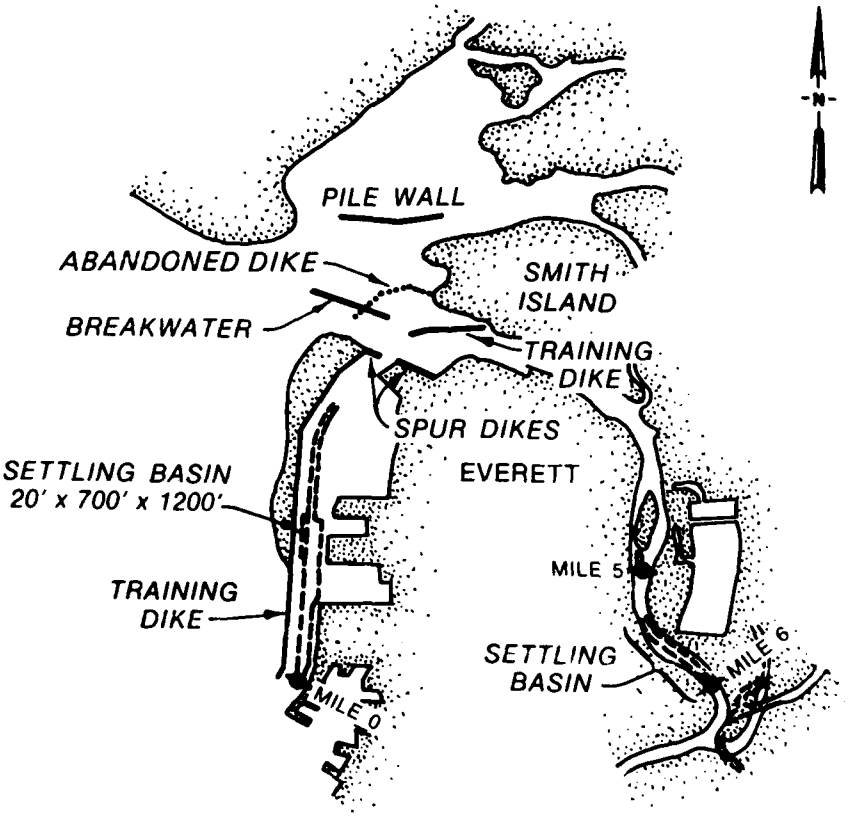

Figure 103. Everett Harbor training structures

training dike, both located at the Gap. A breakwater and abandoned dike are located northwest of the Gap, and a pile wall is indicated to the north in an embayment. The project navigation channel is 150 ft wide and 8 ft deep. The mean range of tide is 7.4 ft.

(NOAA Nautical Chart No. 18444)

Puyallup River, Tacoma Harbor, Washington

121. Site 15d, training walls (jetties). The navigation project provides for the construction of two training walls at the mouth of the Puyallup River (Figure 104). The walls are each about 700 ft long; the west wall is constructed of rock and the east wall of timber piling. The mean range of tides is about 8 ft.

(NOAA Nautical Chart No. 18253)

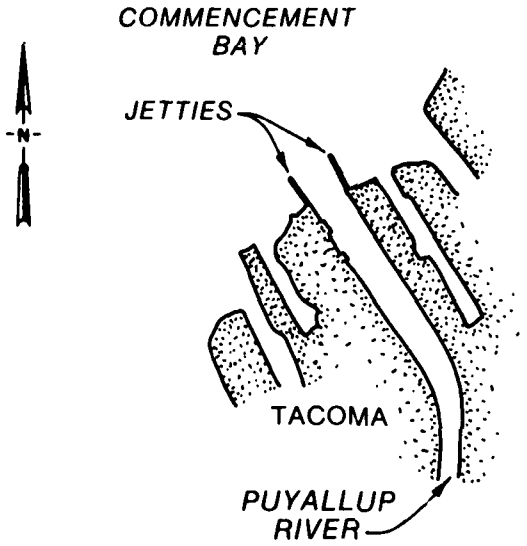

Figure 104. Tacoma Harbor training walls

Quillayute River, Washington

122. Site 15e, dike and training wall (longitudinal dikes). The navigation project provides for a dike with groins on the westerly side of the

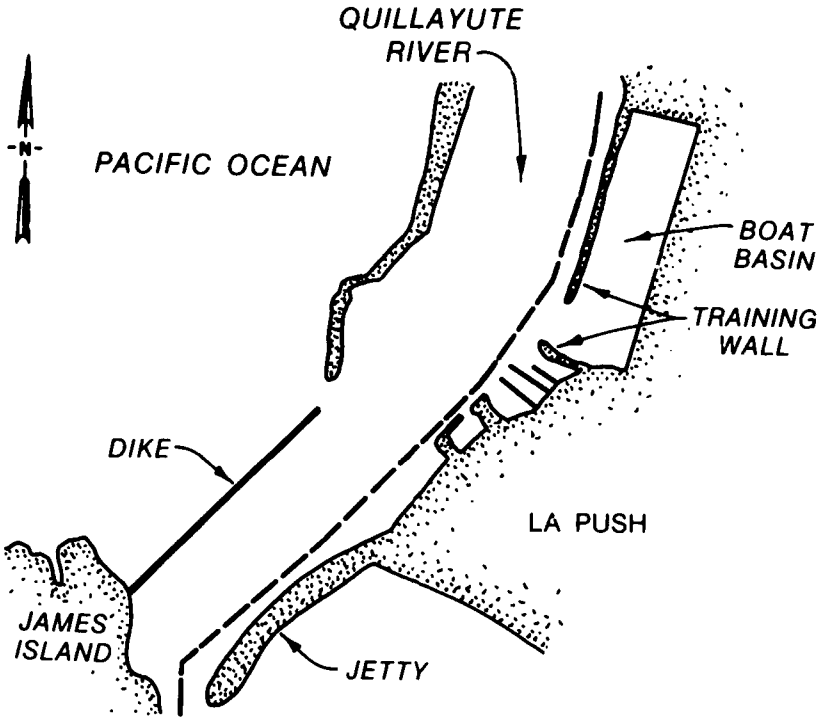

Figure 105. Quillayute River training structures

mouth of the Quillayute River (Figure 105). The dike, 1,050 ft long, was completed in 1960; however, the groins were considered unnecessary and not constructed. A jetty was also constructed on the opposite side of the navigation channel at the same time. The project navigation channel at the mouth is 100 ft wide and 10 ft deep. To lessen maintenance dredging in the boat basin north of the river mouth, a riprap training wall was constructed in 1982 and has been successful. The mean range of tides in the area is about 6.5 ft.

(NOAA Nautical Chart No. 18480)

Grays Harbor, Point Chehalis, Oregon

123. Site 15f, groins (lateral dikes). The navigation project provides for the protection of revetment by groins (Figure 106). The six groins not only protect against wave action and trap some sediments, but most importantly deflect the very strong estuary ebb/flood flows offshore to prevent the undermining of revetment. The mean range of tide is about 6.8 ft at Point Chehalis.

(NOAA Nautical Chart No. 18502)

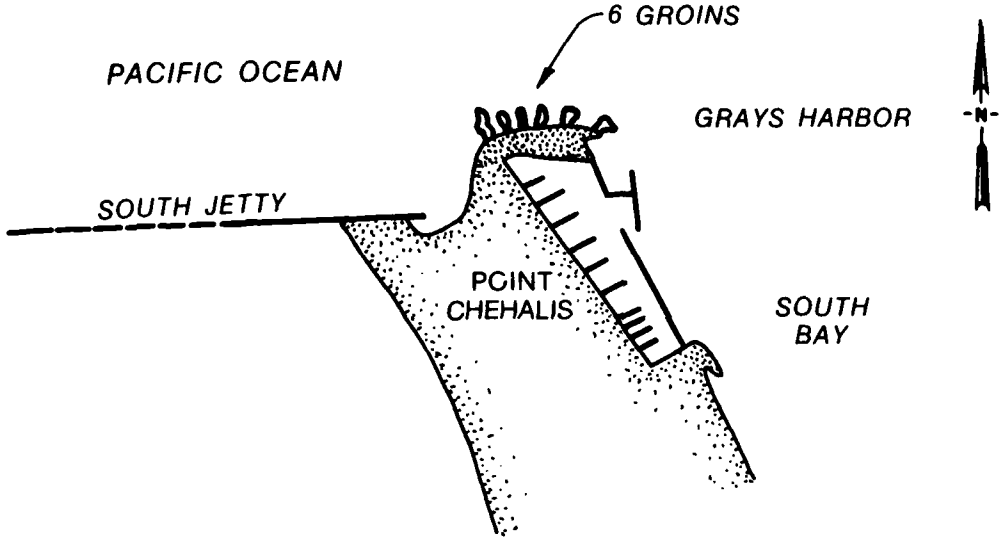

Figure 106. Groins at Point Chehalis

North Pacific Division
Alaska District

124. The Alaska District lists only a few estuarine training structures within the District's jurisdiction (US Army Engineer District, Alaska, 1985): a rock sill and dikes in association with breakwaters. The approximate location of the projects is indicated in Figure 107.

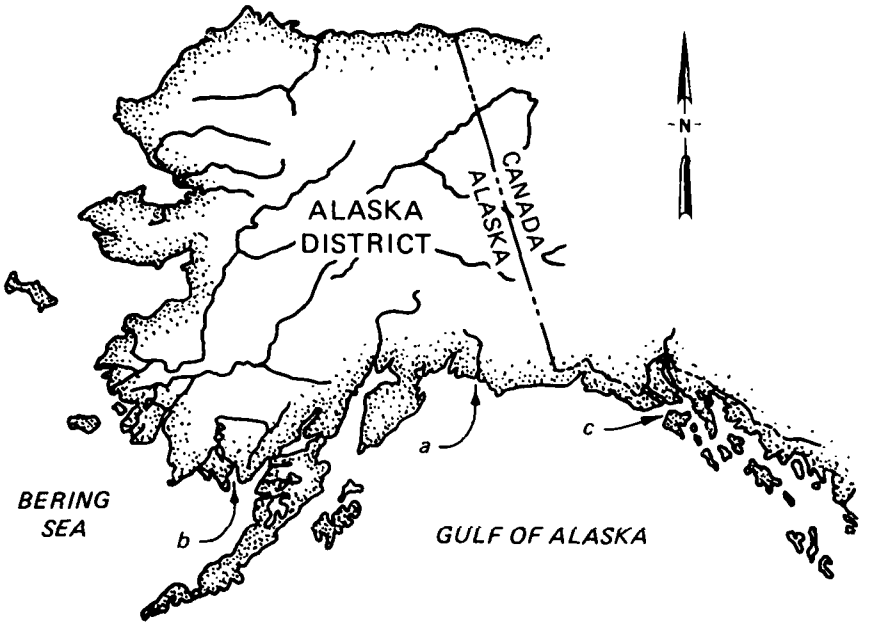

Figure 107. Location Plan 16, Alaska District

Cordova Harbor, Alaska

125. Site 16a, silt barrier (barrier dike). The project, located in Orca Inlet, includes breakwaters protecting the harbor (Figure 108). The "silt barrier" is apparently a type of geotextile cloth or other material, and provides the closing link of the harbor area.

(NOAA Nautical Chart No. 16700)

Dillingham Harbor, Alaska

126. Site 16b, submerged rock sill (barrier dike). The navigation project is located at the entrance of Scandinavian Creek to Bristol Bay (Figure 109). Construction of a rock sill and adjacent scour protection blankets was begun in 1961. The sill was damaged during the winter but was restored

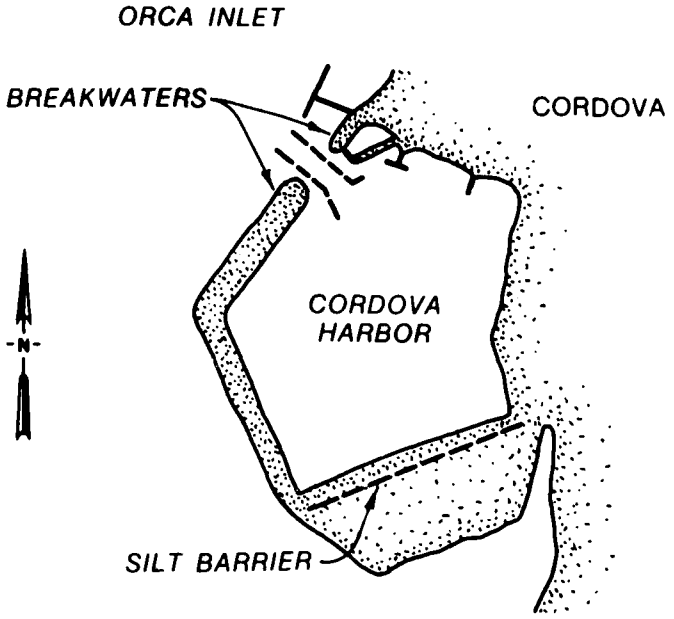

Figure 108. Silt barrier breakwater in Cordova Harbor

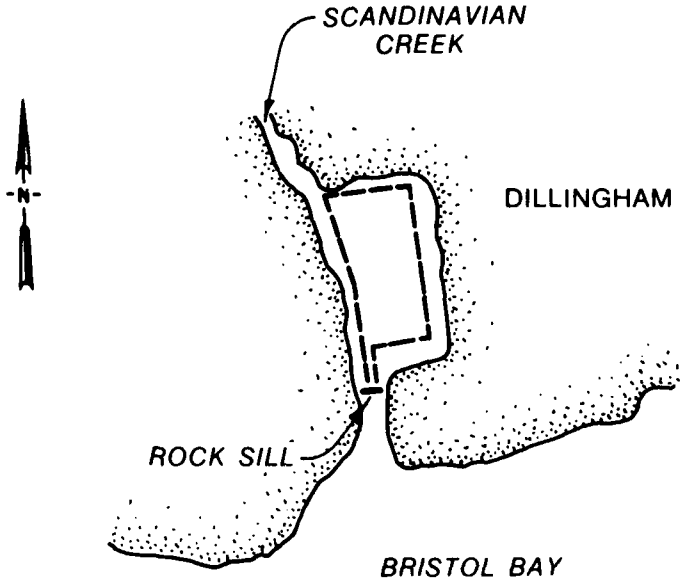

Figure 109. Rock sill in Dillingham Harbor

and completed in 1962. The mean range of tide is 15.9 ft.

(NOAA Nautical Chart No. 16322)

Hoonah Harbor, Alaska

127. Site 16c, diversion dike (lateral dike). The project is located

in Port Frederick on Chichagof Island, southeast Alaska (Figure 110). The harbor is protected by three rubble-mound breakwaters and two rubble-mound diversion dikes. The dikes, 800 and 1,165 ft long, were completed in 1980 and connect to the west breakwater southeast of Pitt Island. The mean range of tide is 12.4 ft.

(NOAA Nautical Chart No. 17316)

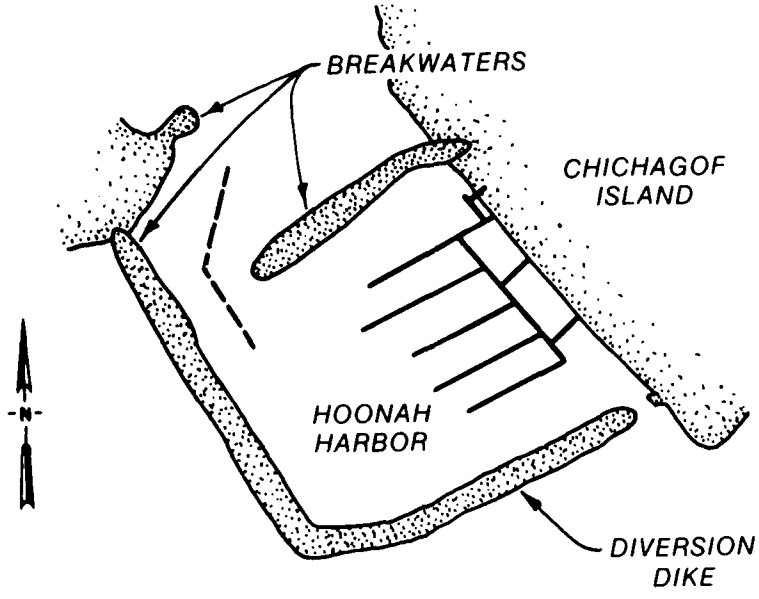

Figure 110. Diversion dikes in Hoonah Harbor

PART IV: SUMMARY

128. The preceding inventory of estuarine training structures was generated by a limited literature search of project maps of the Corps of Engineer Districts. This information provides the foundation for a data base concerning these structures. Since detailed training structure information is generally not contained in the project maps, a statistical analysis at this time would have little meaning. After additional data are obtained in the succeeding phases of the research, a breakdown of structures will be presented by type, material, location, etc.

129. At this time, however, it is known that there are over 554 training structures located in estuaries, of which there are at least:

a. 389 lateral dikes.*

b. 79 longitudinal dikes.*

c. 77 jetties.

d. 15 barrier dikes.

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* The project maps indicated type and/or locations of contraction works without a specific number of structures.

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